



## Lighting Depth- Redesign Work

Club Room

Lobby & Circulation Space

Four Court Gymnasium

Exterior Pathways



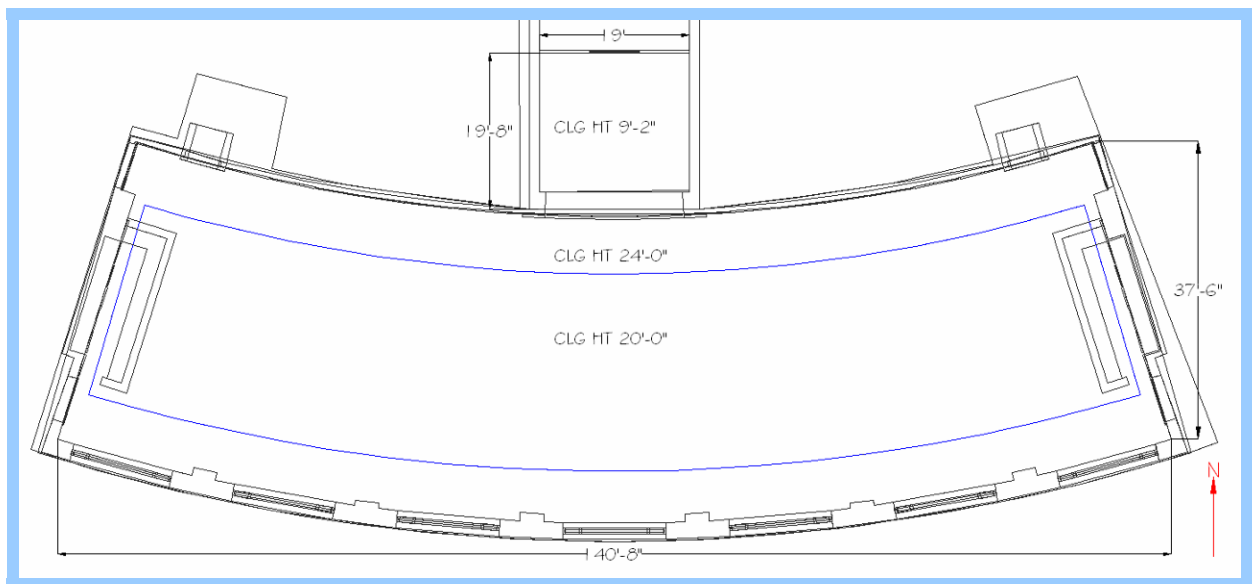
## Club Room

### Overview

The Club Room is meant specifically for special gatherings of VIPs, special donors, and premium shareholders of Boston University. Located above the main lobby, the Club Room is situated on the south end of the Arena concourse level. The two story room is a multipurpose space designed for luxury, with floor to ceiling windows, elegant furniture, and numerous decorative elements. The expansive 5,600 square-foot area features a bar, video screens, and kitchen support areas with a flexible floor plan that can accommodate up to 400 guests.

### *Floor Plan*

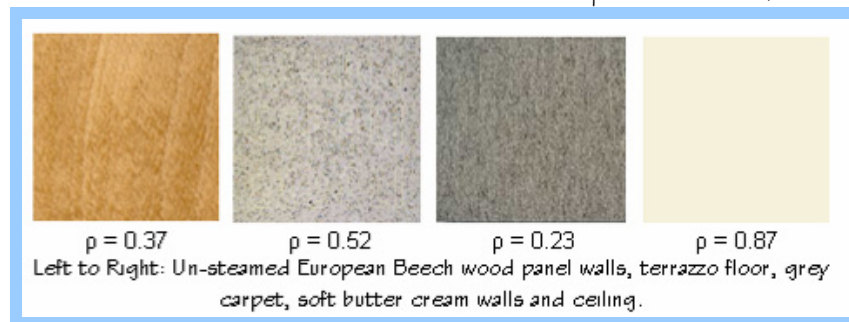
Generally, the Club Room is used as a VIP lounge with no definitive furniture plan. The main entrance to the space is located off the concourse on the North end of the room. Situated on the east and west sides are full cocktail bars with flat screen monitors located directly above the bar, while four other large flat screen televisions are located on the North and South walls. All furniture in the space is more than likely to alter depending on the function; there are couches with coffee tables, high tables with stools, a bar with stools, as well as typical height table and chair sets. The only permanent features within the space are the flat screen monitors and wall hangings in the entrance corridor.





### *Surface Characteristics*

The Club Room is designed with a rich color palette, incorporating warmer earth tones throughout the space. Most of the walls are covered with wood paneling and in the absence of the paneling, the walls and ceiling are painted eggshell white. Tan-grey carpets and terrazzo tiles make up the floor covering. The floor to ceiling windows are clear double-pane insulating glass with a standard low E-coating, and in the case of presentations or events on the television the windows are equipped with black-out roller shades that have an interior color similar to that of the painted walls/ceiling.



The Visible Light Transmittance of the floor to ceiling windows for a typical Low-E is 0.72 and the Solar Heat Gain Coefficient is 0.41. The Visible Light Transmittance of the floor to ceiling windows for a clear double pane is 0.81 and the Solar Heat Gain Coefficient is 0.76.

### Design Criteria

*Main Goal:* To generate a design that creates a comfortable, luxurious feeling for the exclusive guests incorporating several different settings for the different functions. The lighting should not be based on a specific furniture plan except for the main entrance wall hangings and bar area lighting. This system should be very flexible and user friendly.

The appearance of the space and luminaires within the Club Room is an essential aspect of the design. The space is meant for very exclusive members and should have an elegant feel to separate itself from the rest of the Arena. Luminaires should be hidden as best as possible and/or more graceful decorative fixtures should be used for aesthetics, more than purely functional. Another lighting design criterion crucial for the space is system control and flexibility. Because the area is multifunctional without definitive furniture plan, there should be several different lighting scenes to accommodate each usage. In case the function changes often, the control system should be simple and user friendly. Although, hidden from the public eye, the control pad should be in an easily accessible area.



Color appearance is also an important criterion to consider for the lighting design. The space is filled with earth-tone colors such as browns, creams, tans, and grays. The luminaires should have a low color temperature in order to avoid washing out the wood panels and warm colored walls. All general, ambient lighting fixtures should have the similar, if not the same, color temperature to avoid unevenness. Another important factor to consider is the points of interest. Throughout the spaces there are several architectural elements and permanent features such as flat screen televisions, picture frames, and wood paneling that need to be considered when creating a new lighting design. The lighting should either avoid or highlight points of interest. The surface characteristics are also an important feature of the space to think about.

Daylighting integration and control is also an important issue when creating a new lighting layout. The south facing, floor-ceiling windows will bring in copious amounts of sunlight throughout the space. When an event is being viewed on the large flat screen televisions, black out shades will be pulled down, in which case the lighting should accommodate the change. Finally, other important issues to consider for the Club Room lighting design are the target illuminance values. If the space is being used as a lounge the lighting should be adequate enough for reading and working with a horizontal illuminance of about 30-40fc. During social gatherings and formal events in the evening a horizontal illuminance of about 5-10fc is desired. The vertical illuminance throughout the space should be brighter on points of interest and in the case of highlighting architectural or textured elements.

## Design Concept

The Club Room is a very versatile space with an elegant touch. The room was designed to give the VIPs, premium shareholders, and special donors of Boston University a space of luxury separated from the general public. Located on the South end of the Arena, the Club Room receives sun throughout the day from the 20 ft floor to ceiling windows that expand the entire south side. Opposite the windows, the wall is covered with beech wood panels. Other decorative elements include large wall hangings in the entrance corridor, large flat screen televisions, cocktail bars, and a drop ceiling.

When beginning the lighting design for this space, the most important features I want to include are flexibility and user friendly controls. Because the space can be used for daily lounging, sport event viewing, nightly formals, and/or informal social gatherings, the lighting needs to accommodate all of these needs as well as make it simple for the users to control. After thorough research the Lutron Grafik Eye 4000 seemed to be the best control system for this space. With a flexible control system, I was ready to begin the lighting design.



The overall lighting concept is to create a space home-away-from home for the specials guests. This area is “their” space and they should feel welcome and warm at all times. There should also be a touch of elegance in the fixtures. The lighting should not only provide adequate light levels, but should also provide a decorative element within the space. Since the height of the ceiling is about 20ft, the best way to provide lighting on the workplane for possible reading is through a downlight fixture. Inner-mixed with the downlights could be decorative-indirect, but efficient pendants. In order to highlight and bring out the texture of the wood-panel wall a wall washer may be used that also creates movement itself.

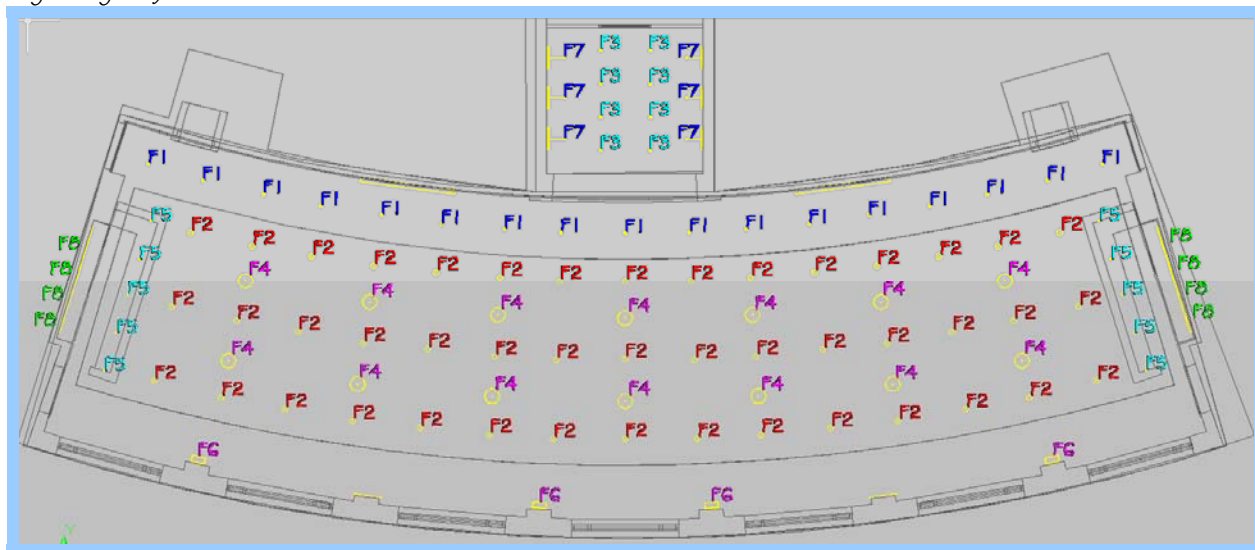
Around the bar area, decorative and more colorful fixtures will be used. Recessed in the shelf behind the bar, a linear-recessed LED fixture will highlight the liquor bottles from below. The fixture will be on a slow color changing sequence that will rotate through the rainbow. Directly above the bar counter itself, decorative pendants will be used.

In the entrance corridor, the main goal is to lead the guests directly to the larger Club Room space. On each side of the corridor, small picture lighting fixtures will highlight the wall hangings. Down the center of the corridor, small downlights that provide just enough light to walk will be used, but the intent is to keep the large room much brighter than the corridor in order to lead people’s attention to the more important, larger space. The large windows will be equipped with black out shades in the event the large screen televisions are being used. Daylighting will be an important element within the space but will not directly control the electric lighting.

Alexis Krest  
Lighting/Electrical Emphasis  
Dr. Mistrick

## Luminaire Plan

### Lighting Layout



### Luminaire Images



Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

### Luminaire Schedule

Label	Description	Catalogue NO.	Lamp			Ballast		Voltage	Fixture Qty.
			NO.	Type	Watts	Type	Lamps		
F1	Recessed wallwash, Low Voltage Halogen	ERCO 22415.023	1	T4 75W 12V GY6.35 2850K Min CRI 82	75	N/A	N/A	120/12	17
F2	Recessed Compact Fluorescent Downlight	ERCO 22227.023	2	CFM 32W GX24q-3 3000K Min CRI 82	32	Electronic Dimming	2	120	45
F3	Recessed Low Voltage Halogen Downlight	ERCO 22403.023	1	T4 50W 12V GY6.35 3000K Min CRI 82	50	N/A	N/A	120/12	8
F4	Compact Fluorescent Pendant with a Natural Spanish Finish	Visa Lighting CP1310-2F39-SA-PB-TL	2	F39BX/SPX30 3000K Min CRI 82	39	Electronic Dimming	2	120	14
F5	Compact Fluorescent Decorative Pendant	Light Concepts 11990-GW	1	CFQ13T35/G24Q 3500K Min CRI 82	13	Electronic Dimming	1	120	10
F6	Compact Fluorescent Decorative Wall Sconce	Visa Lighting CB3616-2F13-SA-PB-TL	2	F13BX/ECO/GX23 3000K Min CRI 82	13	Magnetic	2	120	4
F7	Accent Picture Lights	Halo Lighting LZR800SL	1	20W MR16 12V 2900K Min CRI 82	20	N/A	N/A	120/12	6
F8	Recessed LED Strip Accent Lights	SaVi Accent 300(40.75")	45/ft=150/fixt.	Red, Green, & Blue LEDs	3.5/ft=11.67/fixt	N/A	N/A	120	8

### Light Loss Factors

Luminaire Label	Maintenance Category	LLD	LDD	RSDD	BF	Total LLF
F1	IV	0.95	0.94	0.98	-	0.875
F2	IV	0.84	0.94	0.98	0.95	0.735
F3	IV	0.96	0.94	0.97	-	0.875
F4	VI	0.88	0.93	0.9	0.95	0.7
F5	II	0.84	0.97	0.94	1	0.766
F6	VI	0.86	0.93	0.9	1.02	0.734
F7	I	0.98	0.96	0.97	-	0.913
F8	V	1	0.93	0.98	-	0.911

Assumptions: 12 month cleaning interval and a very clean environment.

### Power Density

Label	Qty	Watts	Total Watts
F1	17	75	1275
F2	45	67	3015
F3	8	50	400
F4	14	80	1120
F5	10	18	180
F6	4	32	128
F7	6	20	120
F8	8	11.67	93.36

Total: 6331.4  
Sq Ft: 5600  
Power Density: 1.1306

ASHRAE 90.1 Power Density Requirements: Using Table 9.3.1.2, Lighting Power Densities Using the Space-by-Space Method, and classifying the Club Room as a "Conference Meeting/Multipurpose Room" within a Sports Arena, the required power density is 1.5 W/ft<sup>2</sup>. Therefore, the achieved power density for this space of 1.13 W/ft<sup>2</sup> is about 24.67% less than the allowed 1.5 W/ft<sup>2</sup>.

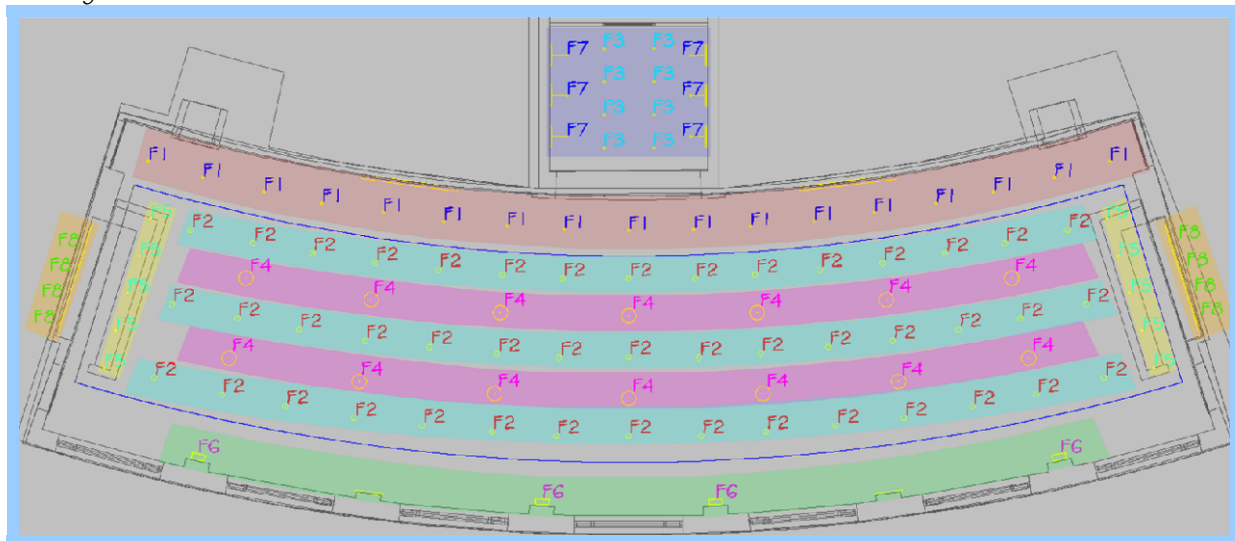


## Control Plan

### Control Equipment

The Lutron Grafik Eye 4000 allows the space to have 8 different zones and 4 different scenes. After doing extensive research, daylighting will not be integrated with the electric lighting due to high costs and lack of constant activity within the space. Instead of using a system that utilizes photosensors with dimming electric lighting, a specific scene will coordinate with the black out shades. The black-out shades will have a corresponding lighting scene that will be manually adjusted by the user. The three other scenes include general lounge lighting for reading and gathering, formal event lighting, and a scene for the users to create on their own depending on the needs of the space. All fixtures will be linked to this system as well as emergency, which is also a nice feature of Lutron's Grafik Eye 4000. The LEDs located by the bars (highlighted in orange below) will be connected to the system as well, but will have a separate wall control. Lutron Grafik Eye 4000 model number: GRX-4108, 4 Gang (1) SB4G.

### Zoning



### Scene Control:

Zone	Color
A	Red
B	Light Blue
C	Dark Blue
D	Magenta
E	Yellow
F	Green
G	Purple
H	Orange

### Scene 1 - General purpose, lounge lighting

Zone A- Wallwashers 100% output

Zone B- CFL downlights 100% output

Zone C- LV Halogen downlights & track lighting 100% output

Zone D- CFL Pendants 50-75% output

Zone E- CFL Pendants 100% output

Zone F to H- OFF





The above scene will create a comfortable ambient lighting, while allowing enough light levels for reading and working. Most of the decorative fixtures will be turned off besides the picture lighting in the entry corridor.

Scene 2- Event on the television and black-out shades are drawn.

Zone A- Off                      Zone B-  $\leq 50\%$  output                      Zone C to E- 100% output  
(Zone H- LED strip lighting set on slow color changing effect)

This settings for the above lighting scene is designed so the majority of the lighting throughout the space is coming from the decorative fixtures. The scene is meant to create a movie theater atmosphere, with the addition of dimmed ambient lighting.

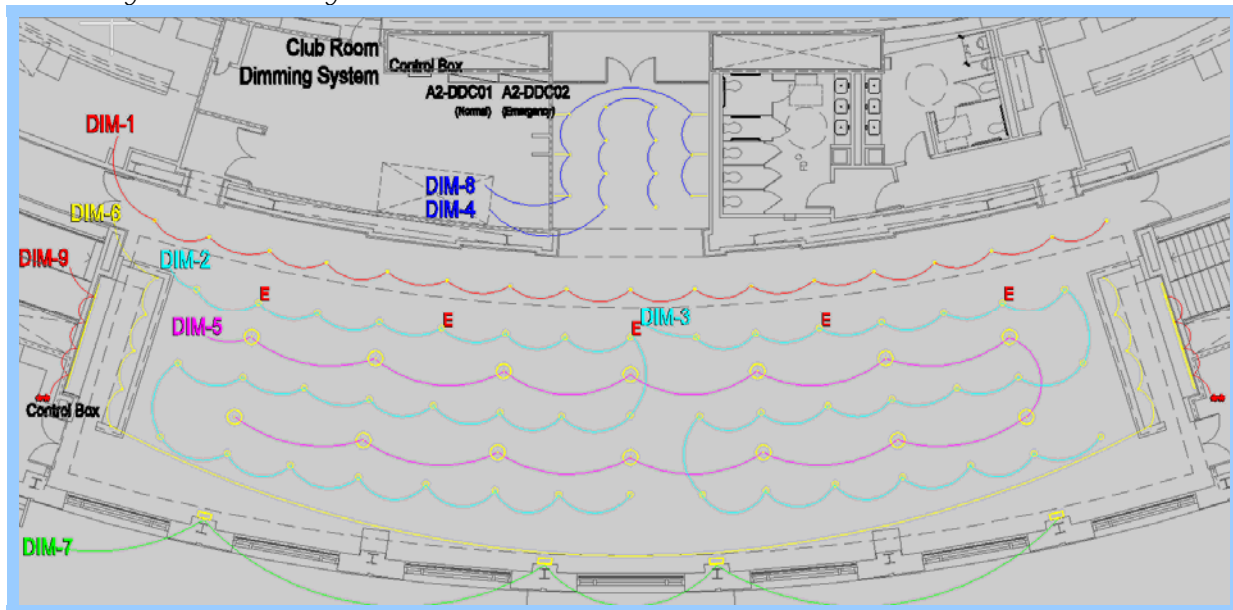
Scene 3- Formal events, social gatherings, evening ambient lighting

Zone A, C to H- 100% output                      Zone B- 50% or less light output

Scene 3 lighting design is meant for formal evening events. Lutron's Grafik Eye systems allows easy adjustment once a scene is selected, so in the event the scene is set for Zone 2 at 50%, the user can use the slider to turn it down or off and it will reset itself to the original settings once the scene is turned off.

Scene 4- To be determined by the user.

*Switching and Circuiting:*



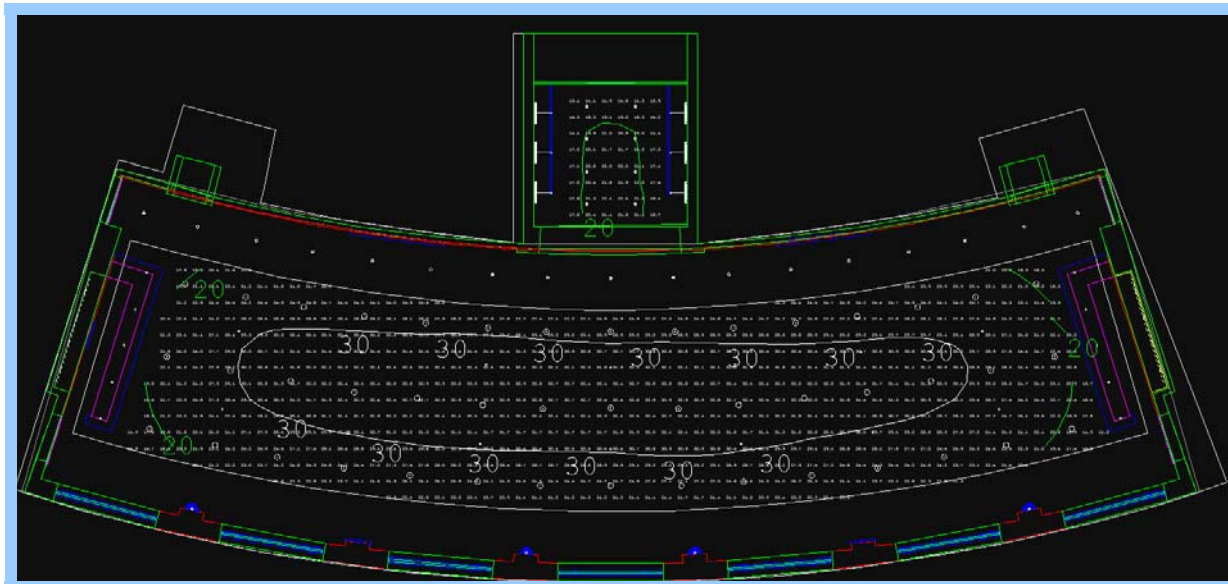
\*The dimming panel is found in the Electrical Depth part of this report under Branch Circuit Redesign/ Club Room.



## Software Calculations

### *Illuminance Levels*

Below is a screen shot from an AGI calculation. *Scene 1* was calculated to make sure the desired 30fc was met, which is required for people to read and carry out other visual tasks. The other calculation points represent the levels met in the entrance corridor for passage. The desired illuminance is about 20fc.



Project 1	
Calc Pts	
CalcPts_1	Illuminance Values (Fc)
	Average=19.05
	Maximum=22.5
	Minimum=12.9
	Avg/Min=1.48
	Max/Min=1.74
CalcPts	Illuminance Values (Fc)
	Average=28.00
	Maximum=33.0
	Minimum=14.9
	Avg/Min=1.88
	Max/Min=2.21

To the right shows the calculation point summary. The first set of calculation points refer to the entrance corridor and are located at a workplane height of 2.5ft. The second refers to the main room area and are located at floor level. Both areas have met the desired illuminance levels.

Main space desired: about 30fc

Main space achieved: 28fc average, 30fc around the center of the room

Entrance corridor desired: 15-20fc

Entrance corridor achieved: 19.05fc avg



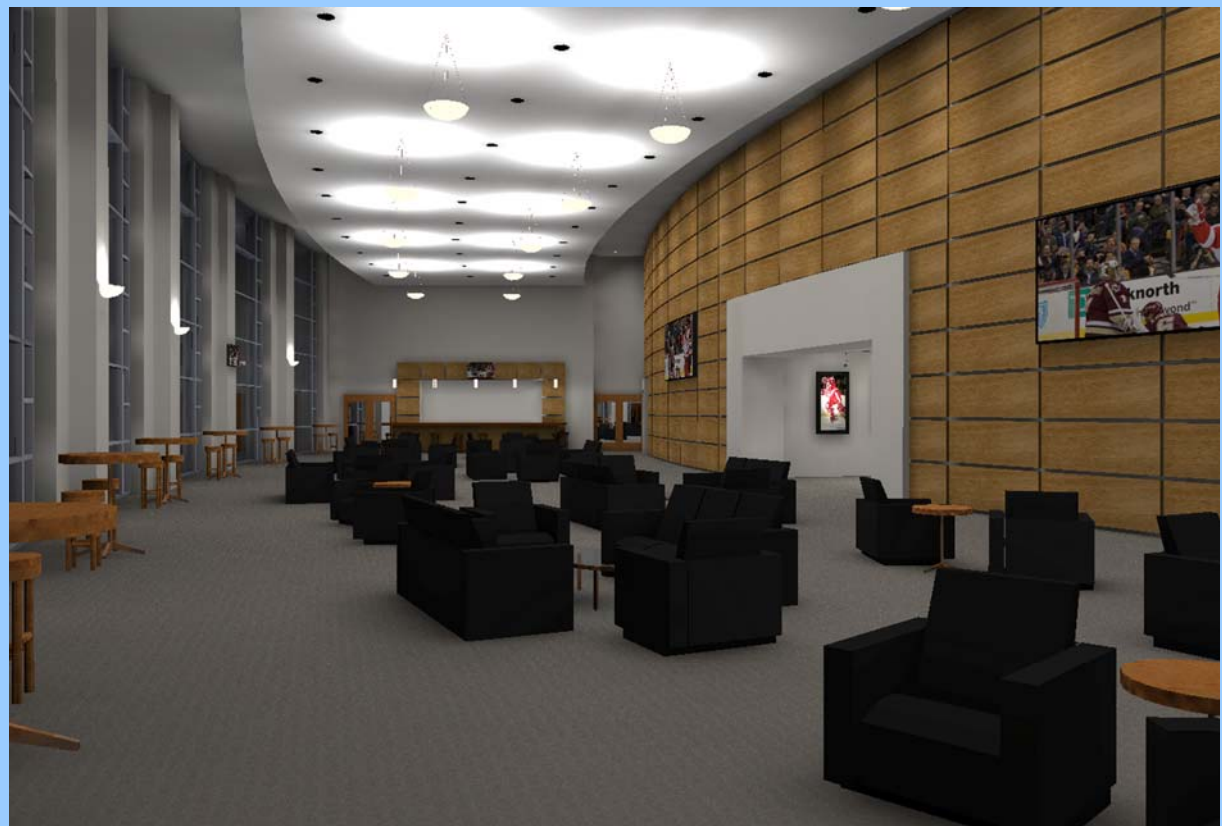
## Renderings

The following renderings are similar to Scene 2 and 3, with Zone B at 0% output.

### *View from the Exterior*

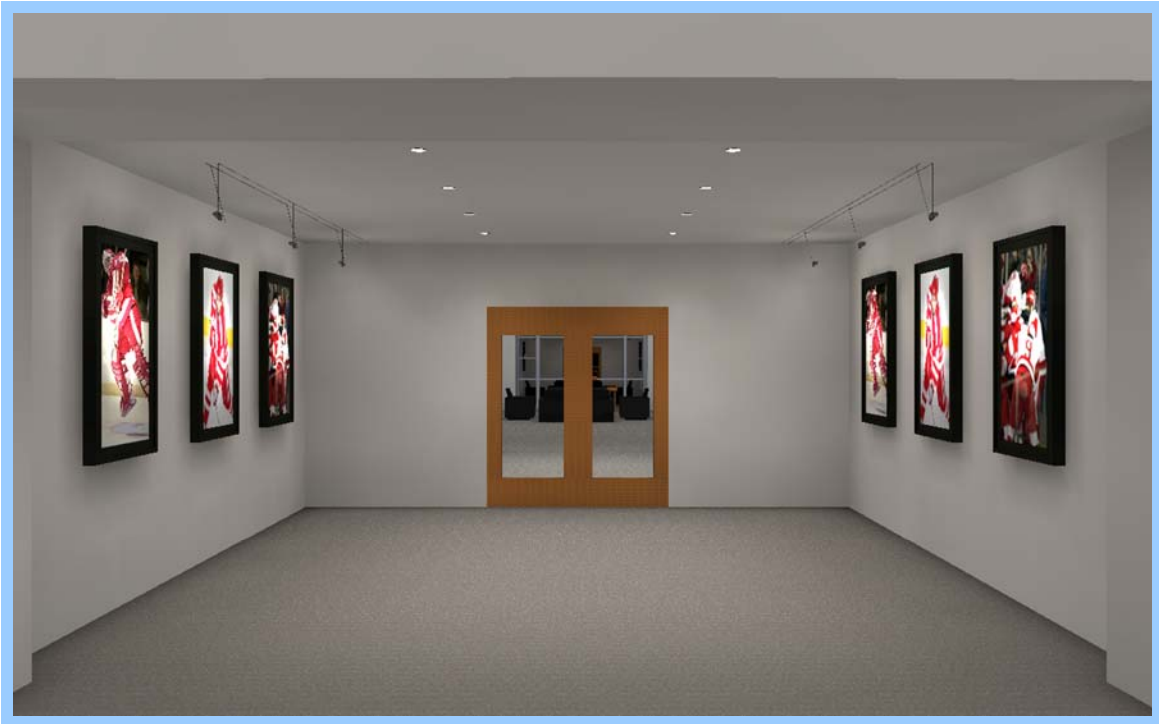


### *View from the East Side Bar*





*View of the Entrance Corridor*

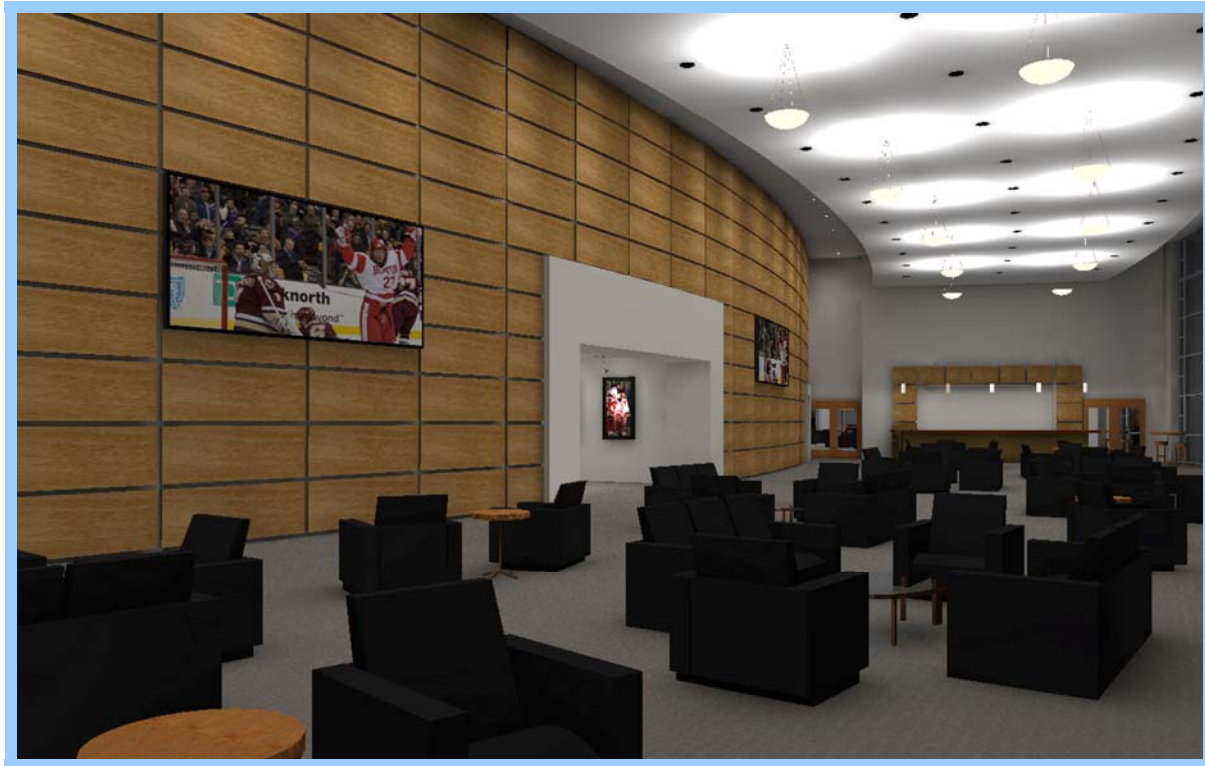


*View of West Side from Entrance Corridor*





*View from West Side Bar*



## Conclusion

The Executive Club Room is an exquisite space for important guests to feel at home. The unique architecture sets the room apart from the rest of the building, creating an atmosphere exclusively enjoyed by the elite members. The wood panels, the curved shape, and the floor to ceiling windows are elements that should be highlighted and taken into consideration when providing a lighting design. For a more formal event, the compact fluorescent indirect pendants and wall scones are perfect to indirectly light space at different levels. The fixtures along the wood paneled wall bring out the texture as well as create movement in the space with the scalloped distribution. The Grafik Eye control system allows the user to easily create scenes for the many different functions and then change those scenes with a click of a button. If the black out shades are drawn the lighting can quickly go from lounge lighting to dimmed indirect lighting. Providing the proper amount of light on the workplane when the space is used as lounge was a main concern and was accomplished using this layout. Overall, I recommend this system to be a good solution for this exclusive multipurpose space; the luminaires are decorative yet functional, creating a pleasant atmosphere for the special guests.



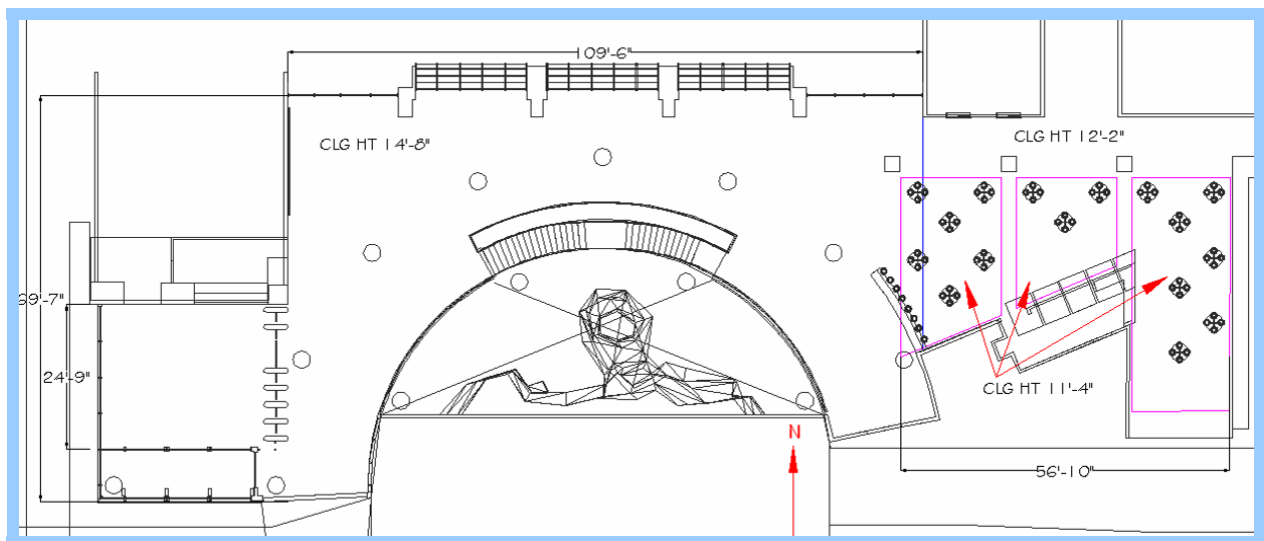
## Lobby & Circulation Space

### Overview

The main lobby of the Fitness and Recreation Center is situated on the south-west corner of the building. Through this entrance students and gym users must show their gym passes and identification cards. The lobby is heavily used by guest and students alike. Once you move beyond the turnstiles (south-west corner), there is a large rotunda with a 35' climbing wall in the center. Opposite the climbing wall is a two-story window that looks directly into the competition swimming pool. From there you can either head downstairs to the racquetball courts, dance studio, or three court multipurpose gym. You may also enter the fitness center which can be accessed on the right side of the rock wall. Another feature of the lobby on the east side is a Juice Bar with tables and stools for athletes to take a breather and quench their thirst. The Lobby space is frequented often and serves as a central meeting area for the Fitness and Recreation Center.

### *Floor Plan:*

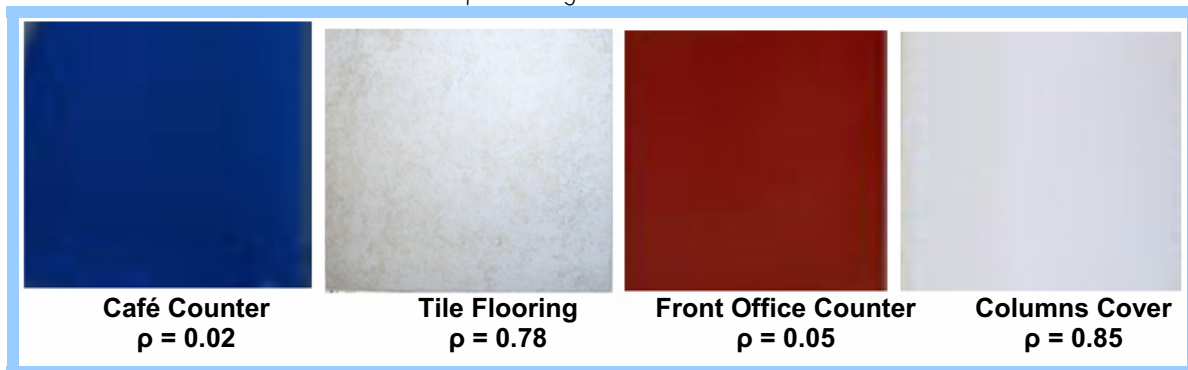
At the top of the drawing there are 4 columns and in between them are floor to ceiling windows which look into the competition pool area. The semi-circle around the rock wall is open to below and the bottom left is the main entrance to the Recreation Center. The signage above the main office entrance and columns are points of interest. The Juice Bar on the bottom right has three drop ceilings directly above the seating.





### *Space Characteristics:*

The main entrance and circulation lobby have a glossy tile finished floor. Most of the walls are white with a few elements painted red or blue. The columns scattered around the rotunda have a white paneling finish.



### Design Criteria

*Main Goal:* To generate a design that provides a functional and creative lighting scheme that contributes to the flow of traffic through the space. The lighting should consider the architecture of the space and highlight the unique elements.

A very important design criterion to consider for the Lobby space is the illuminance levels. Because the space is used often and is heavily populated throughout the day, light levels must be adequate enough for people to walk. The horizontal illuminance should reach about 15-10fc throughout and a vertical illuminance of 5fc for facial recognition. Another important design issue to think about is the appearance of the space and luminaires. The Lobby is used by students, teachers, as well as guests from out of town visiting to watch a sporting event. Therefore, the area should look welcoming and nice for all those using the space. The luminaires shouldn't be an eyesore or too industrial looking.

The points of interest are also important issues to regard when creating a lighting design. On the wall next to the main office is a large bulletin board for public and school oriented postings. The Juice Bar is also an area to highlight with a creative lighting design. Color appearance is another criterion to look into. The surfaces around the lobby are generally white with red accents for Boston University's colors. The color temperature of the lamps should stay similar, if not the same, to keep an even look across the space. The luminaires should avoid causing direct glare. Although daylighting enters the space, it will only be regarded with the entry vestibule lighting. The system control should stay clear of the public eye and should only be accessed by Boston University personnel.



## Design Concept

The overall design concept of the lobby space is to highlight the spatial characteristics and guide people through the space. The lobby has many unique features that should be acknowledged in the lighting design. The central focus is the circular rotunda on a 40ft radius. In order to bring this characteristic out the lighting will follow this same circle. Circular downlights with white or red rims will be aligned around the rock climbing wall. Red and white will be used in order to bring out Boston University's school colors.

Another lighting design concept will look at the architect's purpose for this space. When entering the lobby one has the ability to watch a swim competition, enjoy a cold fruit drink, watch rock climbers, as well as view into the basketball courts. The lobby is central circulation space but it is also an area that is full of Boston University's activity life. In order to bring out the spirit of Boston University students, I would like to incorporate the school pride, the school colors, in the lighting design. I would also like to add some color to the juice bar to highlight the different colors of fruit.

Lighting will be used to bring out points of interest such as the bulletin board wall, signage, and the entrance to the elevators. To keep a clean look, recessed linear wallwashers will be used to highlight the entire bulletin board. Above the Juice Bar recessed downlights with a color changing LED ring will be implemented to create an interesting lighting effect while provided sufficient light levels about the tables for reading purposes.

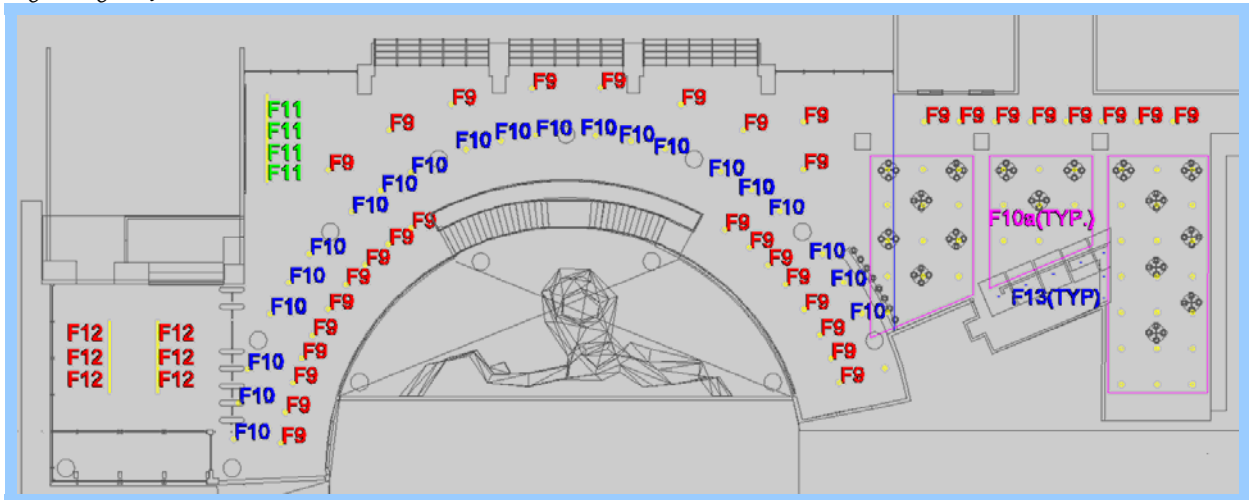
The lobby space is generally very bland in color. The walls, floor, and ceiling are some form of white. The juice bar has some color, but only around the counter. Therefore, adding color for the purpose of the school colors AND for some design aesthetics is also desired. The lighting should also guide people through the space. By following the curve of the columns the lighting will direct one's attention toward the other end of the space where all the activity access points are located.



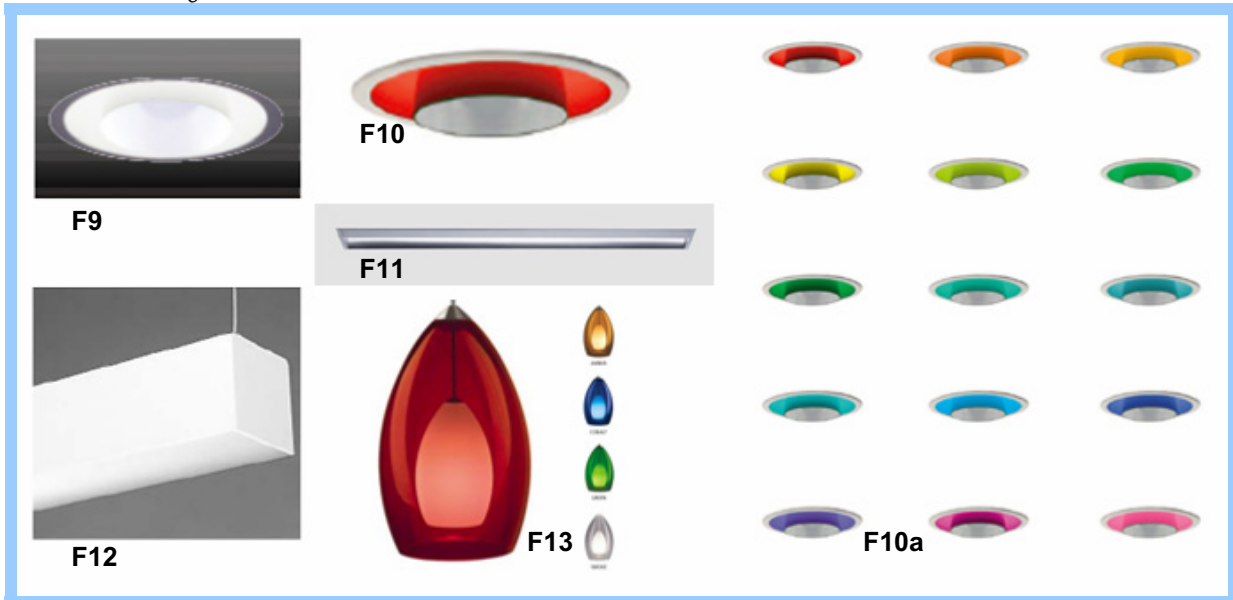
Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

## Lighting Plan

### Lighting Layout



### Luminaire Images



Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

### Luminaire Schedule

Label	Description	Catalogue NO.	Lamp			Ballast		Voltage	Fixture Qty.
			NO.	Type	Watts	Type	Lamps		
F9	Recessed Compact Fluorescent Downlight with Candeo Clear	Gotham Lighting PDGF 1/32TRT 8AR WHT	1	CF32WTRT	32	Electronic	1	277	35
F10	Recessed Compact Fluorescent Downlight with Red LED Ring	Gotham Lighting PDLFV 32TRT 8AR LD	1	CF32WTRT + LEDs	32	Electronic	1	277	22
F10a	Recessed CFL Downlight with Color Changing LED Ring	Gotham Lighting PDLFV 42TRT 8AR LD	1	CF42TRT + LEDs	42	Electronic	1	277	42
F11	Recessed Linear Fluorescent Wallwash	ERCO 65040.023	1	F28T5 Min Bipin	28	Electronic	1	277	4
F12	Linear Fluorescent Indirect Pendant	se'lux M100 1T5HO-C-012-WH	1	F54T5HO	54	Electronic Dimming	1	277	6
F13	Halogen Decorative Pendant	Tech Lighting 700 Color Variation	1	40W T4 G9 Pin Base	40	N/A	N/A	120	6

### Light Loss Factors

Luminaire Label	Maintenance Category	LLD	LDD	RSDD	BF	Total LLF
F9	IV	0.84	0.94	0.98	0.98	0.774
F10	IV	0.84	0.94	0.98	0.98	0.774
F10a	IV	0.84	0.94	0.98	0.98	0.774
F11	IV	0.92	0.94	0.98	1.04	0.848
F12	VI	0.92	0.93	0.9	0.99	0.77
F13	II	1	0.97	0.94	-	0.912

Assume: 12 month cleaning interval and a very clean environment.

### Power Density

Label	Qty	Watts	Total Watts
F9	35	36	1260
F10	22	38	836
F10a	42	48	2016
F11	4	33	132
F12	6	62	372
F13	7	40	280
Total:			4896
Sq Ft:			6500
<b>Power Density:</b>			<b>0.753231</b>

ASHRAE 90.1 Power Density Requirements: Using Table 9.3.1.2, Lighting Power Densities Using the Space-by-Space Method, the gymnasium "lobby" has an allowed maximum power density of 1.8 W/ft<sup>2</sup>. Therefore, the lighting layout of this space of 0.75 W/ft<sup>2</sup> is about 58% less than the allowed power density for this type of space.

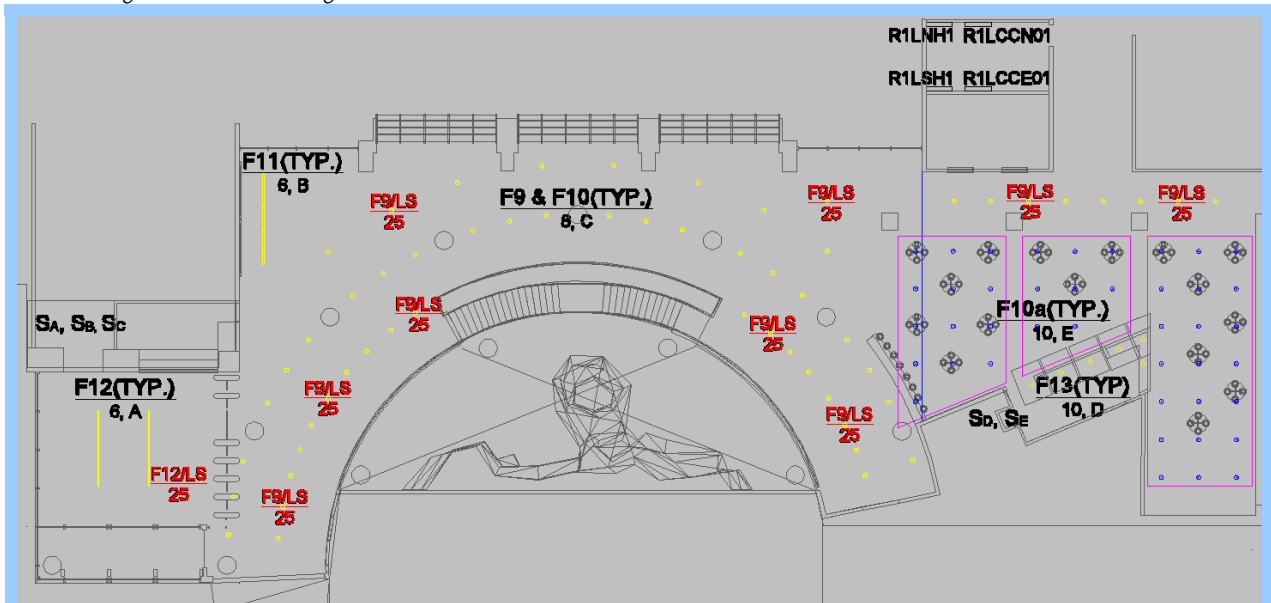
Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

## Control Plan

### Control Equipment:

All normal branch circuits are circuited to panelboard R1LNH1, which is a 480/277 panel. Wire all normal lighting fixtures through low voltage lighting control cabinet R1-LCCN01. All life safety branch circuits are circuited to panelboard R1LSH1. Wire all life safety lighting fixtures through low voltage lighting control cabinet R1-LCCE01. The lighting control cabinet will have dimming controls for circuits 6, 8, and 10. Fixture F12 will be on a timing system. The entire space is surrounded by windows and the sun can provide enough lighting for the area. The fluorescent fixtures will turn on at 4pm and off at 7am. There will also be a manual switch to override the timers.

### Switching and Circuited



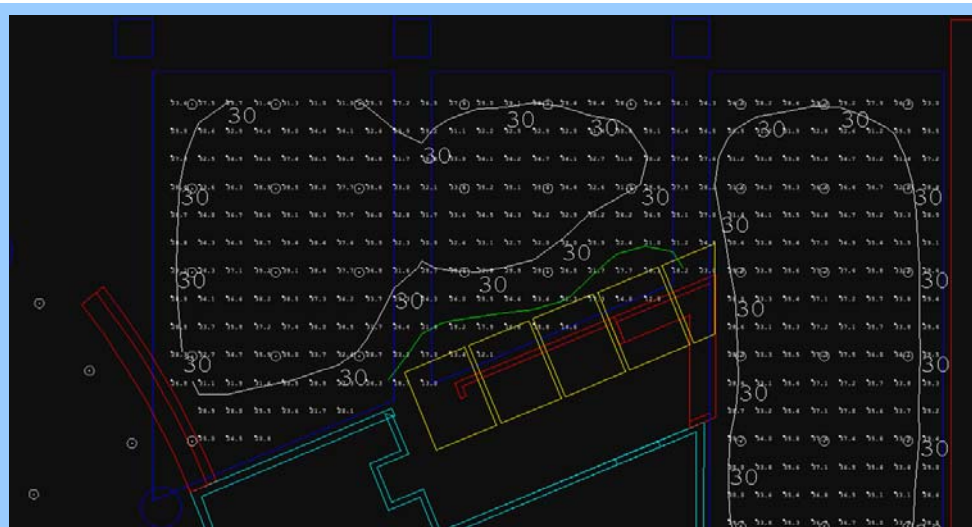
\*The panelboard schedule is found in the Electrical Depth part of this report under Branch Circuit Redesign/ Lobby.

Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

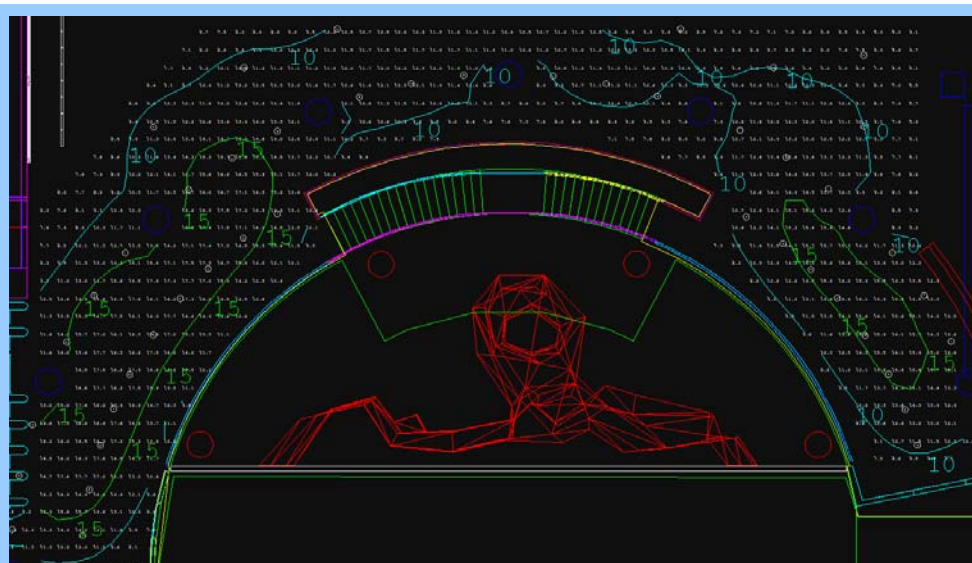
## Software Calculations

### *Illuminance levels*

Below is a screen shot from illuminance calculation points of the Juice Bar area. The desired illuminance level at table height (2.5ft) is between 30 and 40fc for students to read and catch up on homework. From the calculation points and calculation summary it is evident this criteria has been met.



Below are calculation points for the lobby circulation area. The desired illuminance is 10-15fc. By looking at the isolines the achieved illuminance is between 10-15fc & avg 12fc.



Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

## Renderings

*\*Fixtures used to light the rock wall are only there for aesthetics; they are not part of the new design.  
View of the Lobby from Entrance Corridor*



*View of the Entrance Corridor from the Lobby*



Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

*View of Lobby Just Past Turnstiles*

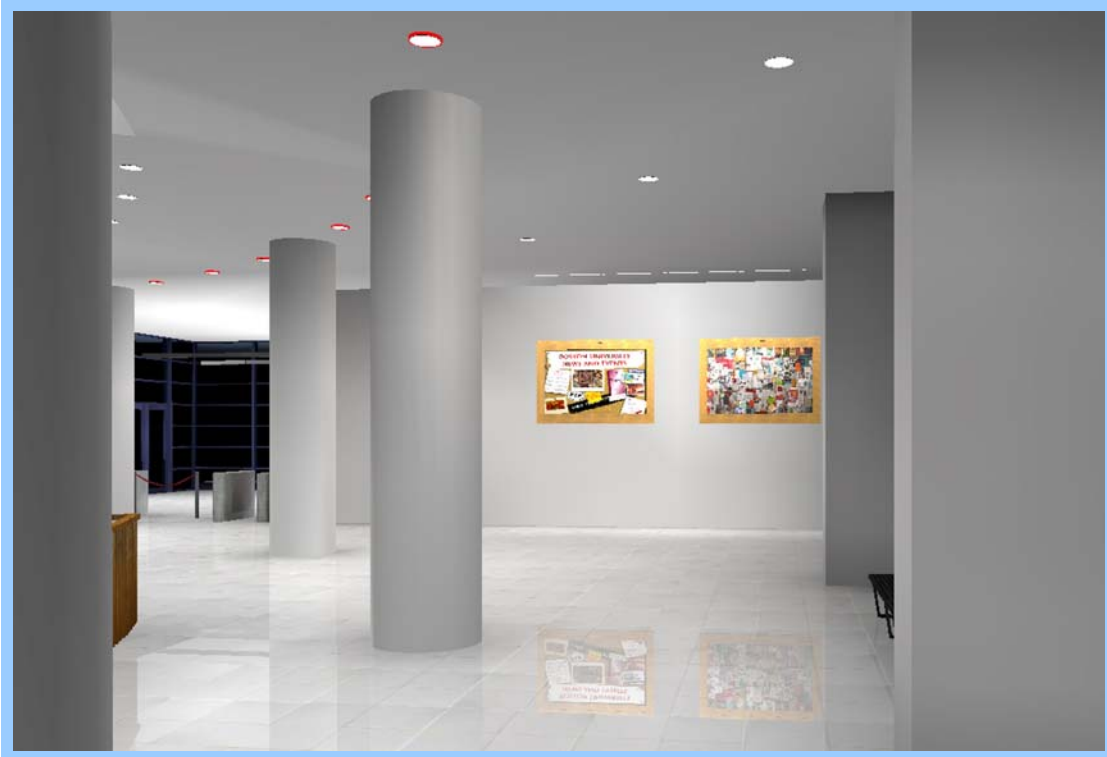


*View of Lobby from Juice Bar*



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Dr. Mistrick

*View Looking Toward Entrance from Elevators*



*Close-up View of the Bulletin Boards*





*View of the Juice Bar*



## Conclusion

The Recreation Center lobby and circulation area is a very busy intricate space. As you walk into the main entrance, you can see a variety of different activities taking place. The large rock climbing wall is a central focal point, and directly across from it a glass wall stands which enables people to peer into the competition swimming pool. The area boldly states movement, energy, and liveliness which were important concepts for the new lighting scheme. The curved architecture also brings out a sense of movement and uniqueness. The compact fluorescent downlights follow the curved shape in order to emphasize the architecture. The red LEDs highlight BU's school colors, as well as add a touch of color that represents energy to the space. The fixtures over the Juice Bar create a colorful element to a very white space and provide adequate light levels for those who want to read and do work at the tables. The lighting is meant to bring out the architectural uniqueness of the space as well as provide adequate light levels for active pedestrian use. The initial goals for the new lighting design were met, while incorporating a creative solution for the Recreation Center lobby lighting.



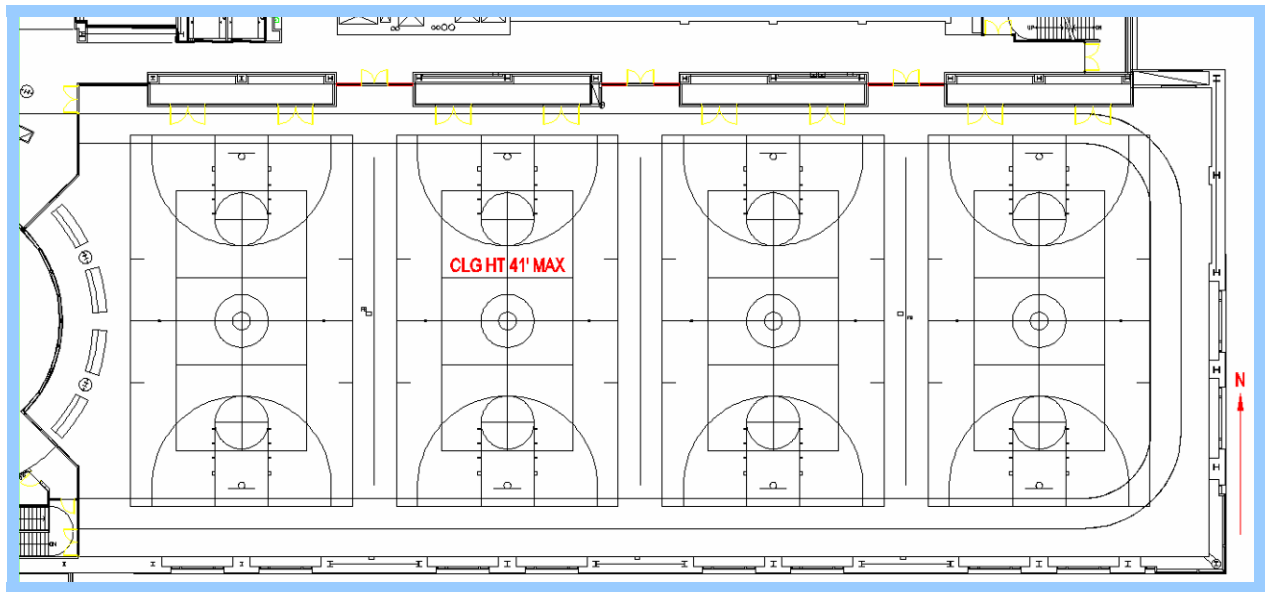


## Gymnasium

### Overview

The 4-court multipurpose gym is mostly used for basketball and volleyball sporting events. A 1/8 mile elevated track encompasses the gym floor. Large two story windows are set in the south and east facing wall. Red and white accent colors are used throughout the space in honor of Boston University's school colors.

### *Floor Plan:*



### *Space Characteristics:*

The gym floor is a light, glossy wood paneling. The walls and ceiling are painted white. The windows in the gym are a laminated vision glass, 9/16" thick with a pattern frit in the middle of the two glass layers. The custom stripe frit pattern has a 60% coverage and the stripes are 1/8" thick. The glass is manufactured by Viracon and has a transmittance of 0.74.





## Design Criteria

*Main Goal:* The gymnasium lighting design should incorporate the use of daylighting and durable fixtures, as well as create a brightly lit space for athletic activities.

From Figure 20-1 in the IESNA Handbook the basketball facility is in Class III (No special provision for spectators), and from Figure 20-2 under Basketball/Class III the recommended illuminance levels are listed. The IESNA recommended horizontal illuminance for the gym floor is about 50-80fc and 30fc for the track floor, which is very important to meet.

Daylighting integration and control is also a very important design criterion for the gymnasium. The floor to ceiling windows on the south and east sides will bring in an abundant amount of daylight throughout the day, which could be used as an advantage. In order to minimize energy and maximize the advantages of the sun, photosensor control of the electrical lighting may be a solution to the lighting design system. The daylighting and electric lighting should be integrated together to create enough illumination on the gym floor, whether dimming or shutting off the electric overhead fixtures.

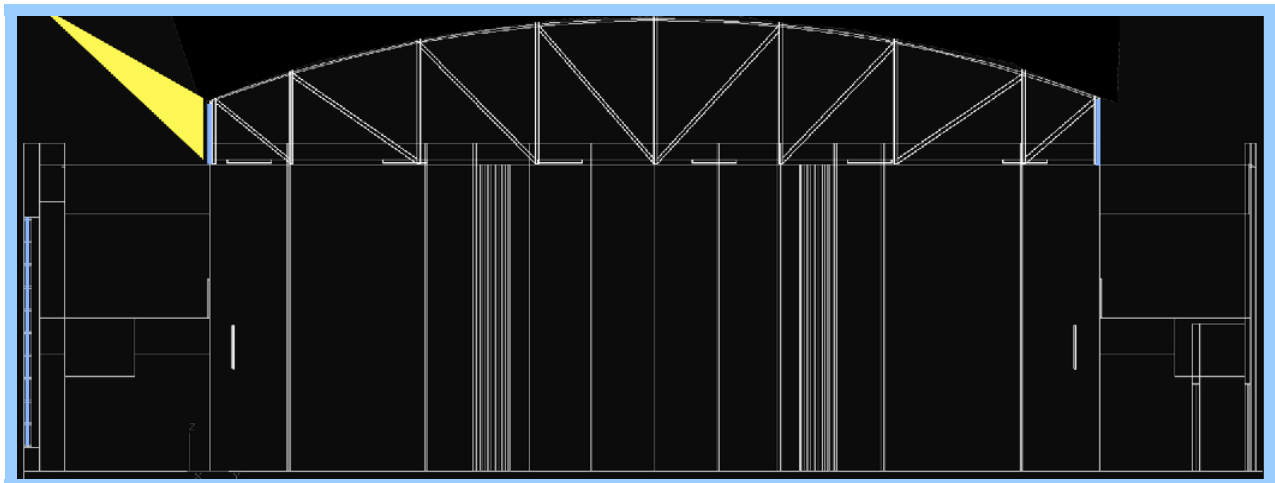
Direct glare is another important criterion to consider for the gymnasium lighting design. The fixtures should avoid direct glare into the athlete's eyes. No fixtures should be installed directly above the backboard. Currently the glass windows have a custom frit between the two panes which should eliminate direct glare from the sun, or at least make it as minimal as possible.

Another important lighting design aspect to consider is the light distribution on surfaces. There should be an even distribution on the gym floor; the IESNA recommended illuminance ratio max:min is about [1.7-2.5]:1, or less. The walls and ceiling do not need too much attention with light distribution, unless there are display cases and/or posters, in which highlighting these areas may be desirable. There should also be an even light distribution on the elevated track. Although an indoor track is not mentioned in the IESNA, an outdoor track max:min should be about 2.5:1, or less.



## Design Concept

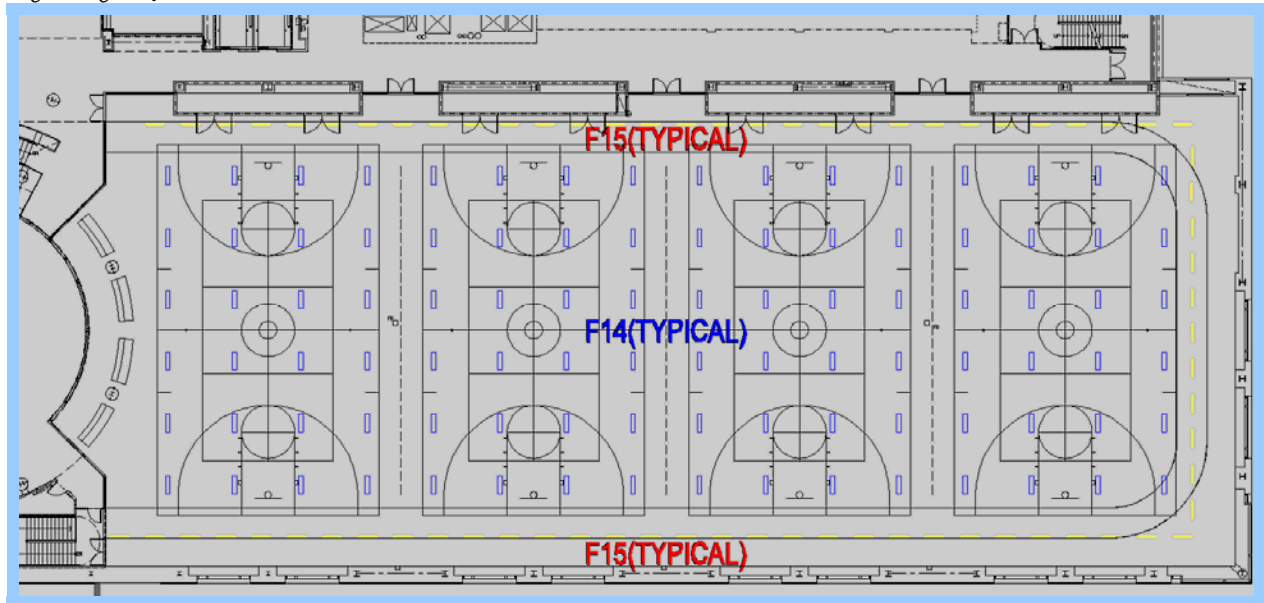
The basic lighting design concept for the gymnasium is to create a feeling of playing basketball outdoors. The sunlight will shine through the south facing windows, while clerestories will be added to the south and north facing structure of the roof. In order to minimize energy usage, dimmable hi-bay fluorescent fixtures will be implemented and controlled by photosensors. A simple section of the clerestory addition is shown below. The blue indicates glass; to the left of the photo is the floor to ceiling, south-facing windows. The shape of the roof-truss system is unaltered, but the north and south sides were solid walls that are now made into windows that run the length of the gym. The clerestory glass will be the same type of glass used in the south facing windows.



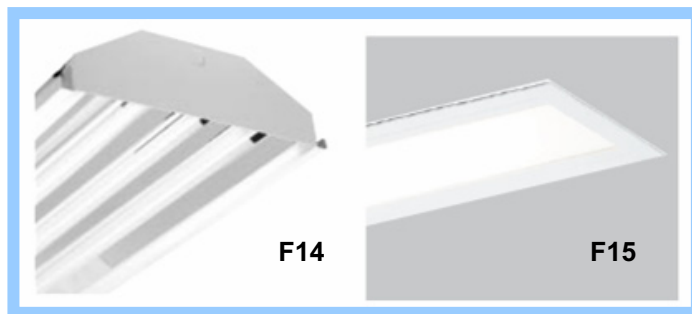


## Lighting Plan

### Lighting Layout



### Luminaires Images



*\*Although not depicted here, Fixture F14 will have a wireguard accessory for protection from athletic equipment.*

### Luminaire Schedule

Label	Description	Catalogue NO.	Lamp			Ballast		Voltage	Fixture Qty.
			NO.	Type	Watts	Type	Lamps		
F14	Suspended Linear Fluorescent High Bay Industrial Fixture	Stonco Industrial Lighting T-Bay Series	4	F54T5HO	54	Electronic Dimming	2	277	90
F15	Recessed Linear Fluorescent	Litecontrol Mod <sup>a</sup> 2 R-D-4400 Series	1	F54T5HO	54	Electronic	1	277	146



### Light Loss Factors

Luminaire Label	Maintenance Category	LLD	LDD	RSDD	BF	Total LLF
F14	IV	0.92	0.89	0.97	1	0.794
F15	V	0.92	0.88	0.97	1	0.785

Assume: 24 month cleaning interval and a very clean environment.

### Power Density

Label	Qty	Watts	Total Watts
F14	180	125	22500
F15	73	125	9125
		Total:	31625
		Sq Ft:	25400
		<b>Power Density:</b>	<b>1.245079</b>

ASHRAE 90.1 Power Density Requirements: Using Table 9.3.1.2, the gymnasium “playing area” has a maximum power density of 1.9 W/ft<sup>2</sup>. Therefore, the lighting layout of this space of 1.25 W/ft<sup>2</sup> is about 34% less than the allowed power density for this type of space.

\*Power density calculations based on a 2 lamp electronic dimming ballast input watts.

## Control Plan

### Control Equipment

The gymnasium is equipped with dimmable fluorescent high bay fixtures in order to install photosensor controls. The fluorescent fixtures at 100% output provide adequate light levels for night time lighting, but during day time hours the sunlight may provide enough light for the fixtures to be dimmed and possibly turned off. A daylighting study was conducted in order to determine the illuminance levels found in the gymnasium throughout the day. The calculation points were placed only around the four-court gymnasium area because it is the most important area in which the critical point(s) that control the photosensors must be determined to keep the required light levels.

The Daylight Study was conducted during three different days of the year: March 21<sup>st</sup> 2007, June 21<sup>st</sup> 2007, and December 1<sup>st</sup> 2007. The sun during December and June months is at its most extreme angles (the highest sun angles in June and the lowest sun angles in December). This is why those two months were chosen for the daylight study. March is in between the two months and corresponds to September, which are good estimates of the sun levels between the extreme (high and low) sun levels. The calculation points with their corresponding RGB renderings and pseudo colors are found in Appendix B as well as the critical point analysis.

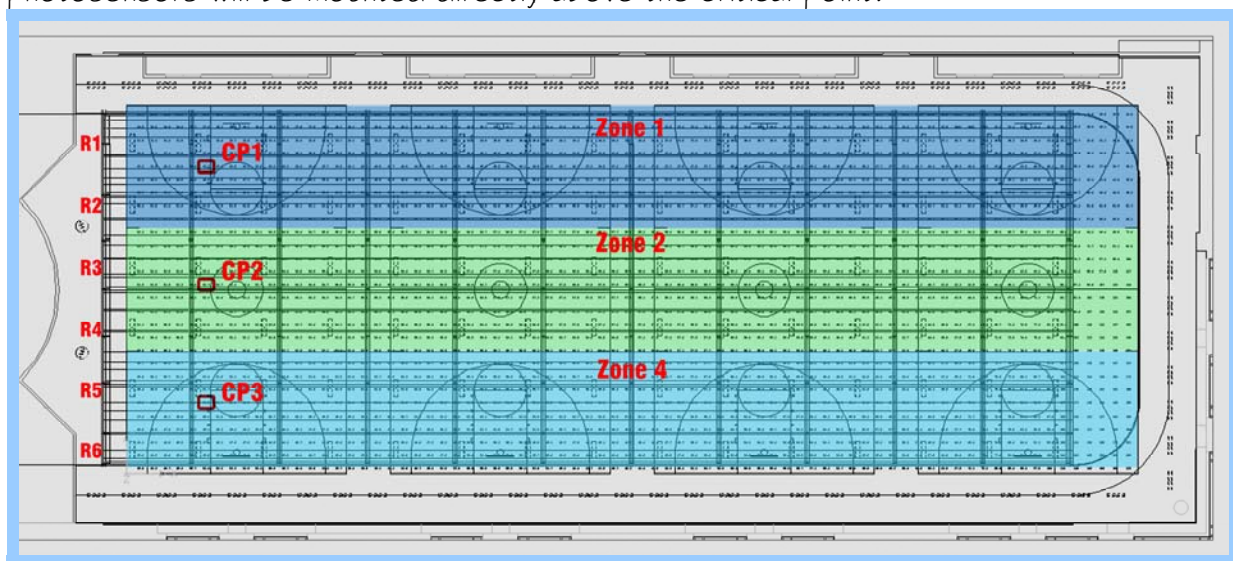
### Control Schedule

After analyzing the calculation points for the three different sample days of the year and their corresponding times, the best way to divide the different dimming zones seems to be from north to south. This means that the Zones will run parallel with the south facing window. The calculation points tend to increase gradually from the north



end of the gymnasium to the south end. A Wattstopper LS-301 Dimming Photosensor will be placed directly above three different critical points. Each zone will have a photosensor dimming control, which also means a critical point must be found within each zone. In order to minimize the effect each photosensor has on one another, the critical points must be placed away from one another. After thoroughly analyzing the data, three different critical points were selected one for each zone.

Below is an image of the zoning with the corresponding critical points. The photosensors will be mounted directly above the critical point.



Zone 1: Row 1 and Row 2, CP1, Photosensor 1, Maintain 80fc

Zone 2: Row 3 and Row 4, CP2, Photosensor 2, Maintain 80fc

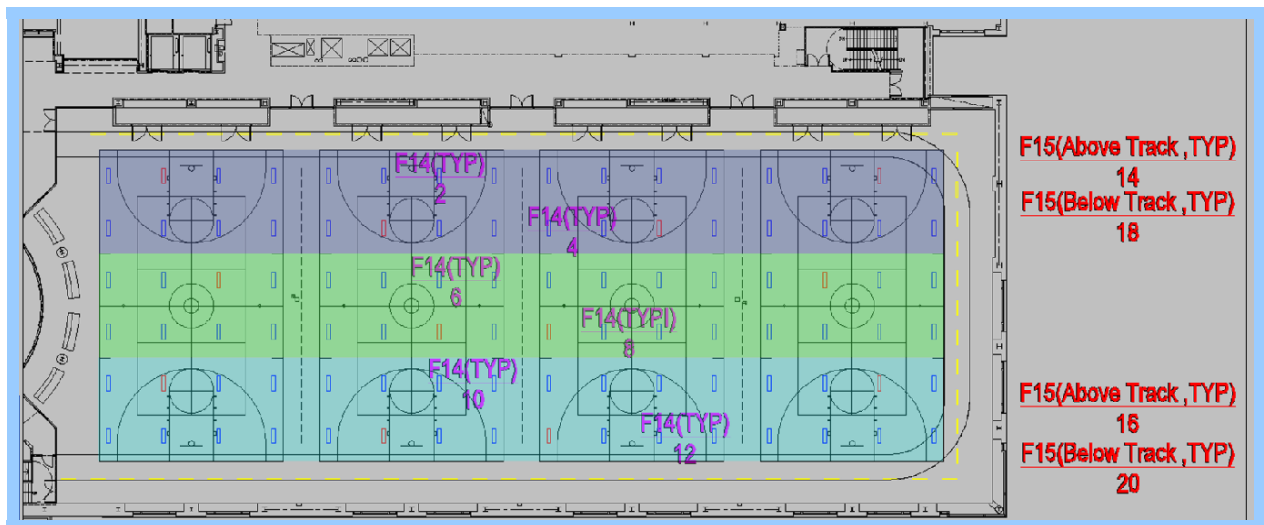
Zone 3: Row 5 and Row 6, CP3, Photosensor 3, Maintain 80fc

All normal branch circuits are circuited to panelboard R3LNH1, which is a 480/277 panel. Wire all normal lighting fixtures through dimming, low voltage lighting control cabinet R3-LCCN01. All life safety branch circuits are circuited to panelboard R3LSH1. Wire all life safety lighting fixtures through dimming, low voltage lighting control cabinet R3-LCCE01. The lighting control cabinet will have dimming controls for circuits 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20.



### Switching and Circuiting

Below is an image of the circuiting plan. In order to make the drawing more clear to see on this page, the labeling was simplified. The recessed fixtures above and below the track, F15, has been circuited by floor level than by side of the gym (north or south). The high bay fixtures, F14, have been circuited first according to zone, then by row. For example, Zone 1/Row 1 (closest to the gym doors on the north end) of fixtures are all on one circuit, circuit 2. The red fixtures are categorized as emergency and are circuited to the emergency panel on circuit 4. The panelboards are located in an electrical room just north of the elevators (top left corner).



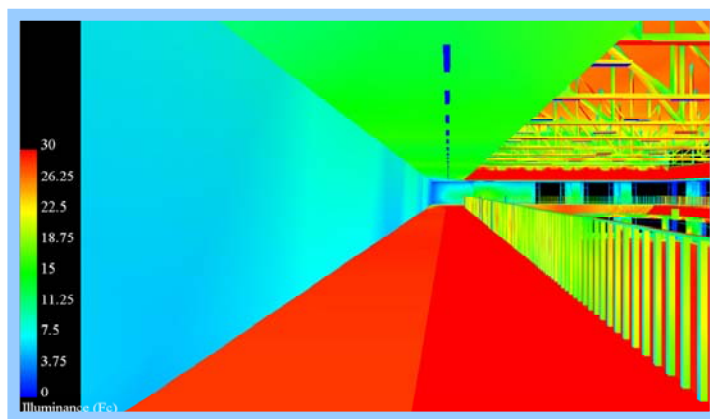
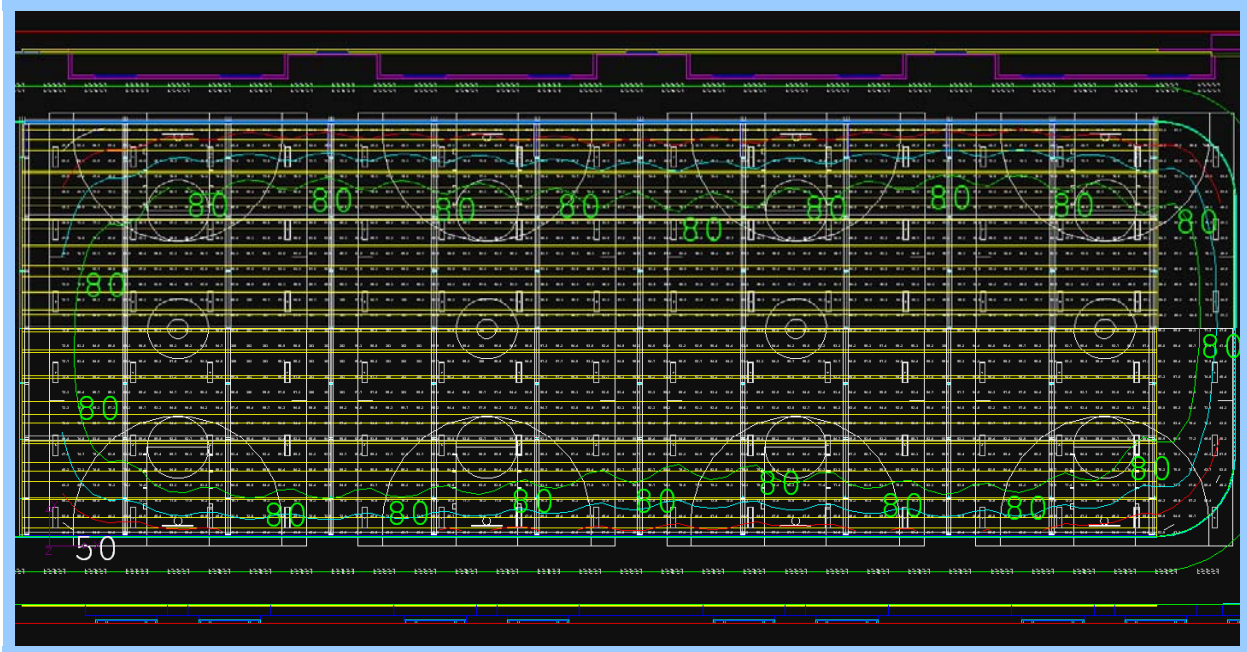
\*The panelboard schedule is found in the Electrical Depth part of this report under Branch Circuit Redesign/ Gymnasium.



## Software Calculations

### *Illuminance levels*

Below is a screen shot from the electric lighting only AGI simulation. The desired average illuminance level is 80fc and the desired illuminance maximum to minimum ratio is (1.7-2.5) : 1.



Project 1	
Calc Pts	
CalcPts	Illuminance Values (Fc)
	Average=83.28
	Maximum=103
	Minimum=41.3
	Avg/Min=2.02
	Max/Min=2.49

The Figure on the left is a pseudo color representing the illuminance levels on the track floor. The red is 30fc and the blue is 0fc. The recessed fluorescent fixtures adequately light the track floor evenly. The Figure on the left shows the calculation summary from the Gymnasium Floor AGI simulation.

The average illuminance levels reached 83fc on the floor, which is above desired and the max:min ratio reached 2.49:1 which meets the desired criteria. The fluorescent lighting reaches the required light levels as well as keeping an even distribution on the gym floor.

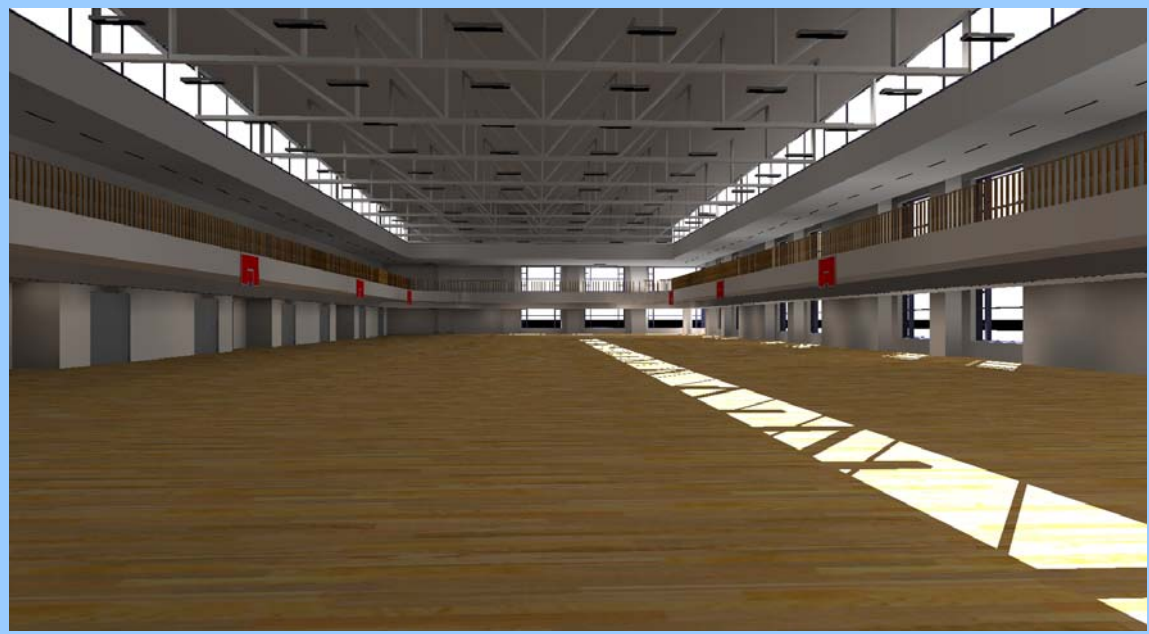




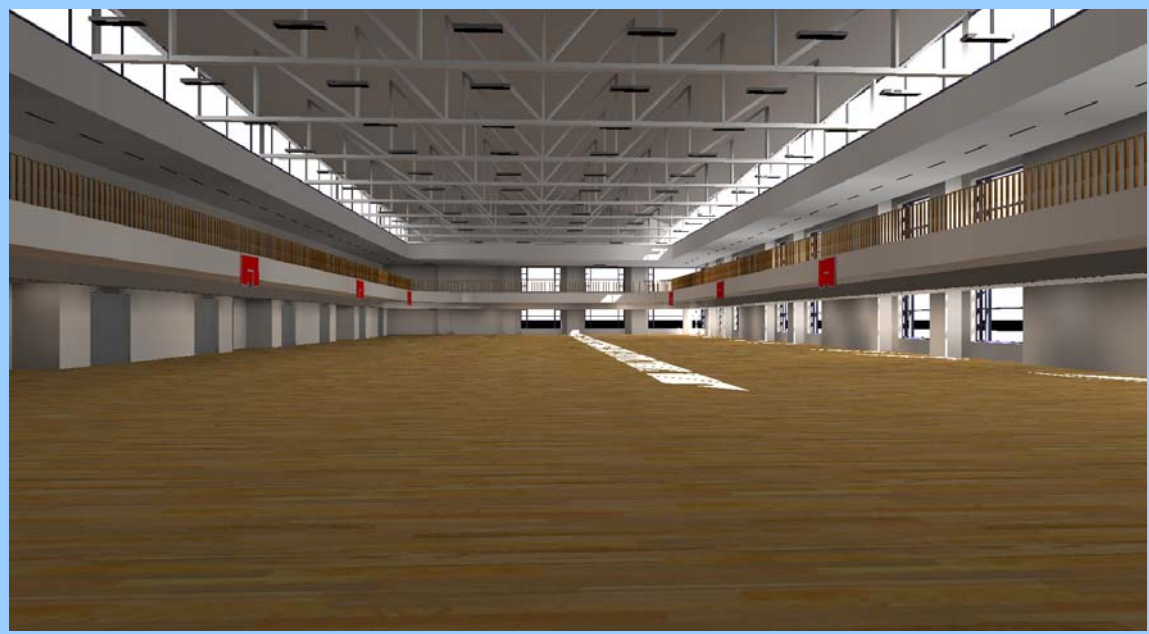
## Renderings

Below is a small sampling of renderings from the daylighting study, the remainder renderings are found in Appendix B. There are also electric lighting renderings found below.

*March 21<sup>st</sup>, 2007 9am*



*March 21<sup>st</sup>, 2007 3pm*

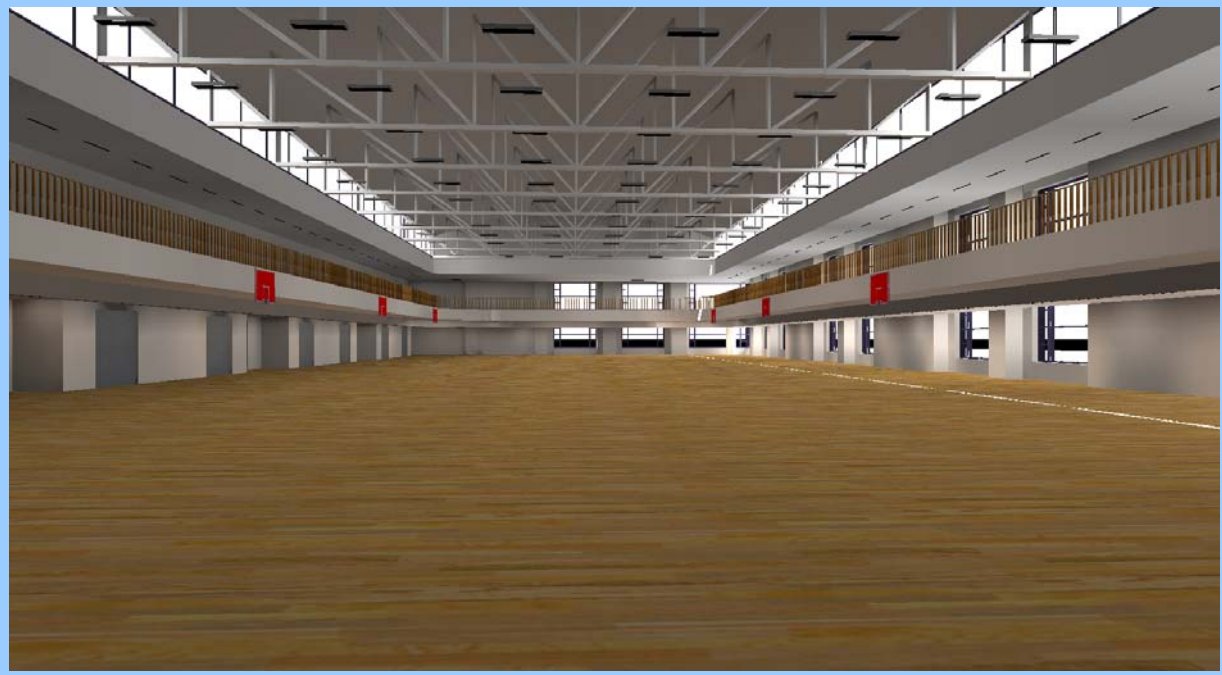


Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

*June 21<sup>st</sup>, 2007 9am*

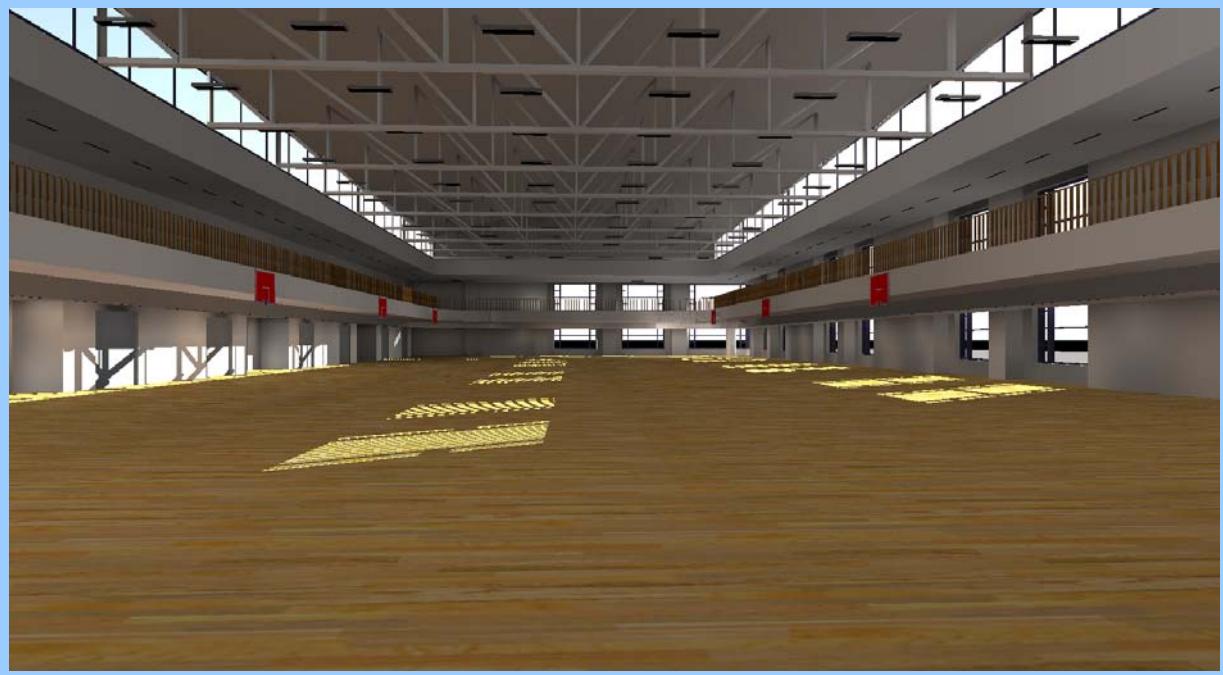


*June 21<sup>st</sup>, 2007 3pm*

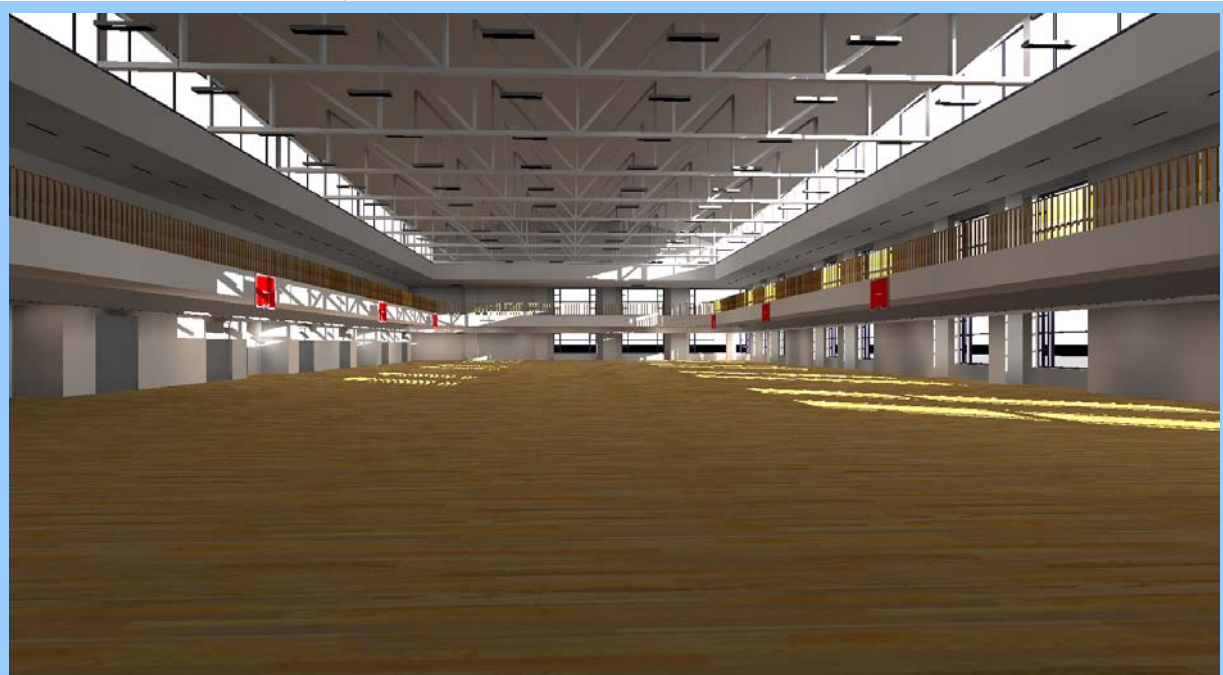


Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

*December 21<sup>st</sup>, 2007 9am*



*December 21<sup>st</sup>, 2007 3pm*

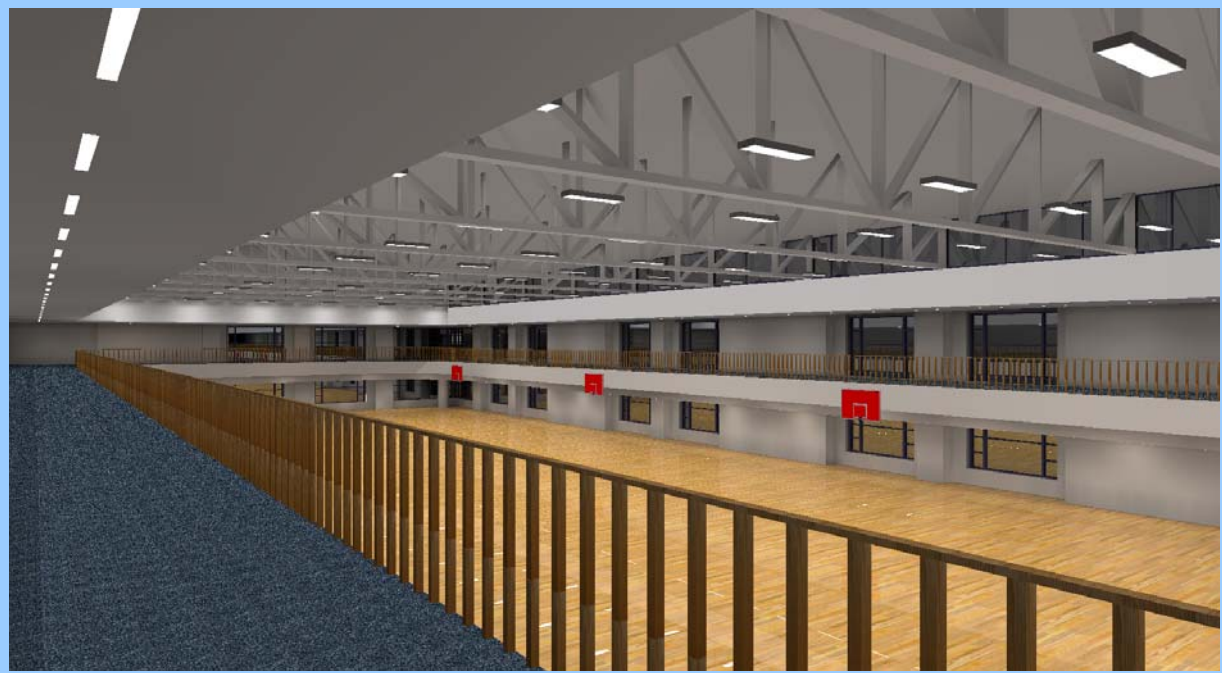


Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

*View from West End of Gymnasium*

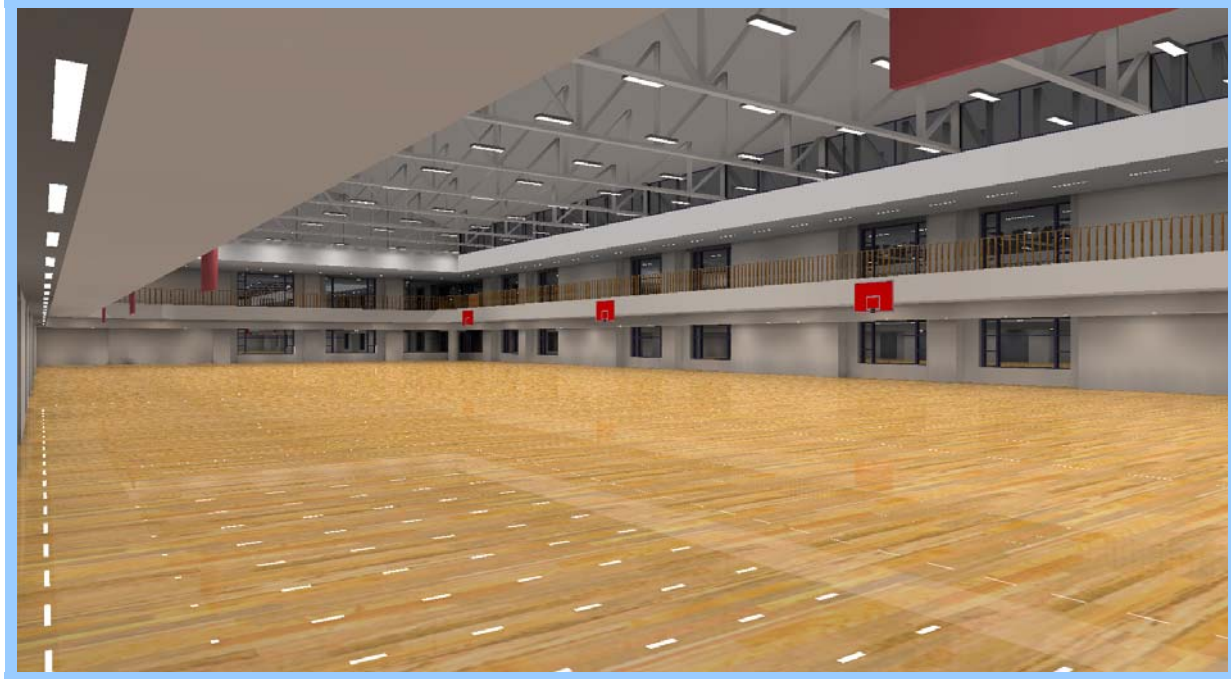


*View from North-West End of Track*





*View from North-West Side of Gym*



## Conclusion

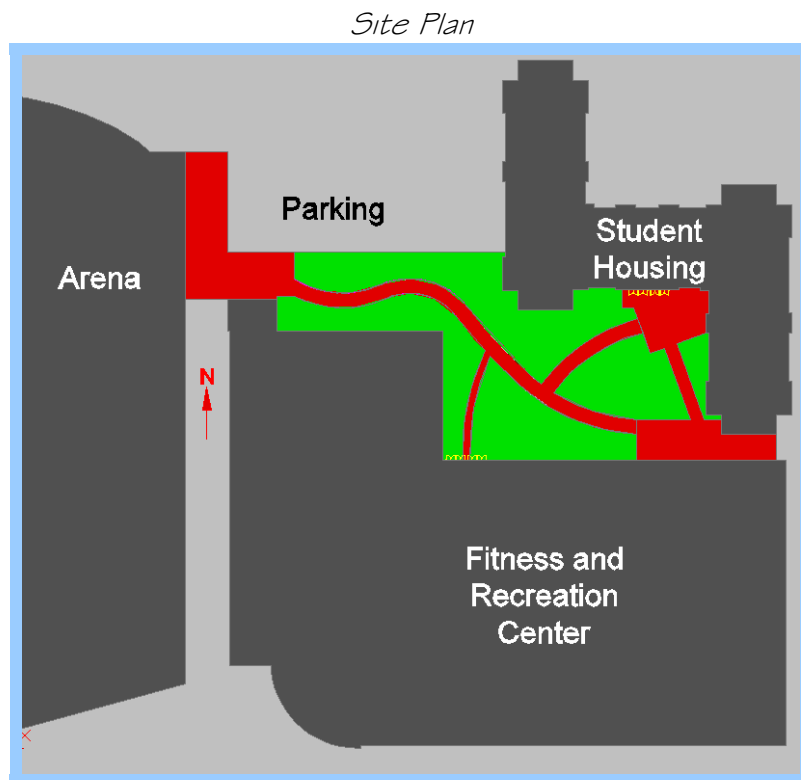
The recreational gym design took a simple space and added creative architectural elements such as, the encompassing elevated track and the floor to ceiling windows. The main goal for the gymnasium lighting design was to incorporate daylighting. The south facing windows bring in copious amounts of sunlight throughout the day, and with the addition of the north and south facing clerestories more sunlight was capable of entering the space. The high-bay linear fluorescent fixtures allow the system to be controlled by photosensors. After conducting the daylight study, during some points of the day the fixtures don't even need to be turned on. The recessed fluorescent fixtures above the track are meant to provide enough light levels for running as well as create a sense of movement around the gym. The high-bay fixtures emphasize the linear trusses and align over each court to avoid direct glare over the backboard. The daylighting integration and control will minimize the energy usage during daylight hours by dimming the fluorescent fixtures while providing enough light on the gym floor. The new lighting design is simple yet creative solution for this space.



## Exterior

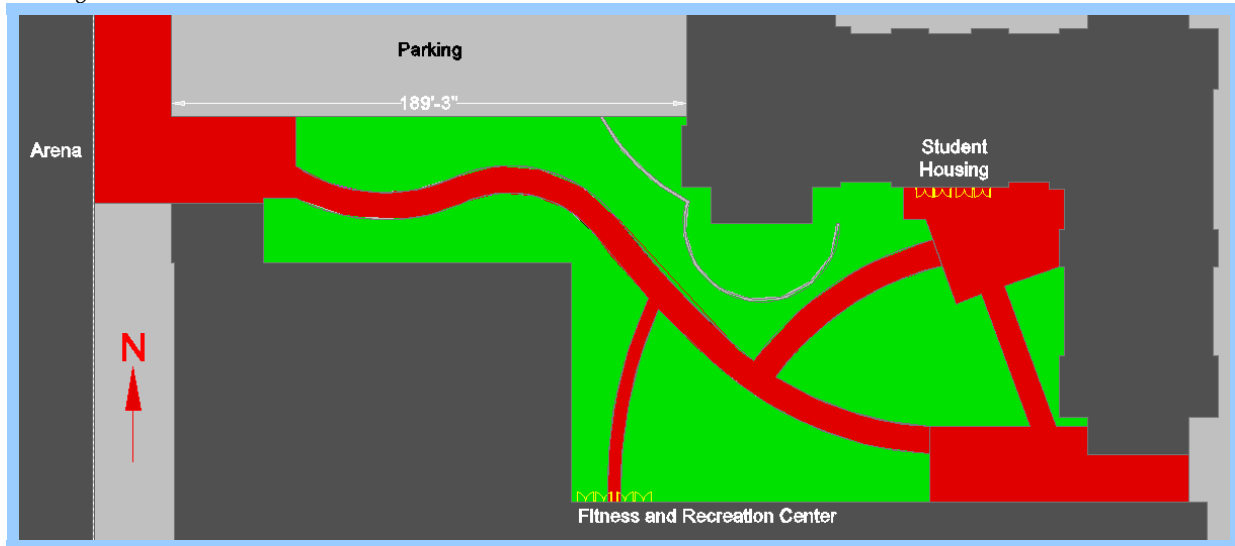
### Overview

The Student Village Project, including the Arena and Recreation Center, main goal was to merge the east and west ends of campus. Because the design focuses on making the hub the “center for activity”, the pedestrian traffic through this area will be heavy during all hours of the day. The main circulation path runs right between the Arena and Recreation Center then ends up in a courtyard area which must be adequately lit for safety. The Arena holds events that may carry into late hours and the Recreation/Fitness Center is open late for student convenience, so careful consideration must be taken into account for student safety. The façade and walkways are mostly brick with concrete planters and steps. The central courtyard between the Student Housing, Recreation Center, and Arena is used often with pathways leading to entrances of each building.





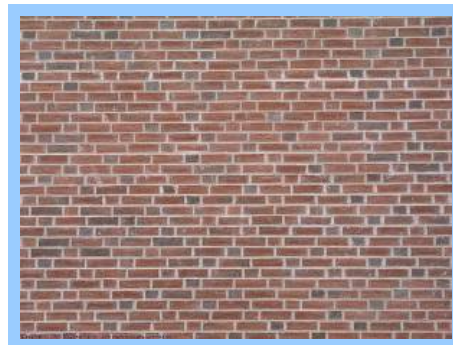
### Enlarged Site Plan



### Surface Characteristics

The façade and walkways within the Student Village Project are mostly brick with soft white pre-cast concrete blocks. There are many large windows throughout the building façade and a large rotunda at the Recreation Center entrance that is entirely double-pane glass. The interior of the signature rotunda features a state of the art fitness center and elevated track. At night people passing by can see directly in on the activities carrying on in the space. The windows outside the 3 court gym are also accessible for pedestrians to peer in on the athletic activities taking place. The Arena, Recreation Center, and Student Housing have many windows on the ground floor level. At night pedestrians can clearly see in and vice versa.

*\*The reflectance of the brick below is 26%.*





## Design Criteria

*Main Goal:* To generate a design that provides safety for students during evening hours, while achieving dark-sky compliancy.

An important design criterion to consider for the exterior plaza on a campus setting is the illuminance level reached throughout the space. According to the IESNA Handbook, the horizontal illuminance for a plaza should reach about 5fc and the vertical illuminance should reach about 3fc. The horizontal illuminance is important for pedestrians to see while walking through the area, while the vertical illuminance is necessary for facial recognition of other pedestrians. The target horizontal illuminance for this particular lighting design will fall in the range of 2-5fc.

Another important issue regarding the lighting design of the exterior courtyard is the appearance of the space and luminaires. The area can be seen from three different, heavily used buildings: The Arena, The Recreation and Fitness Center, and Student Dormitories, therefore it should be pleasing to the eye. The luminaires should be simple, yet decorative. Because the surrounding facades and pathways are a rich brick, the luminaires should generally have a warmer color temperature to bring out the color, opposed to washing the colors out.

Direct glare is also a concern for exterior lighting designs. All fixtures should have a coating or enclosure to avoid direct glare. The luminaires used should not cause strong direct glare for pedestrians that may impair their vision. Avoiding too many dark areas around the pathways is preferred. The illuminance uniformity ratio on the walkways and entrances should be no greater than 4:1, max: min.

Another major criterion considered for this design is light pollution into the buildings and dark sky compliancy. Dormitory windows as well as other building windows surround the courtyard, so light into these areas needs to be avoided. At night, if students are trying to sleep, the annoyance of a bright light that they cannot control is far from desirable. Dark-sky complaint fixtures will also be a consideration. In order to avoid adding more light pollution into the Boston sky, the new lighting design will take a look at different types of dark-sky compliancy.





## Design Concept

The entire courtyard is surrounded by buildings. Located to the north is a student dormitory, south is the Fitness and Recreation Center, and to the West is the Arena building. When creating a lighting design for this area, dark sky compliant fixtures and light pollution *into* the buildings are generally very important to the lighting scheme. In order to avoid light entering into the dormitory windows the fixtures will have a direct lighting distribution onto the surface below. The walkways will be illuminated for safety and visibility.

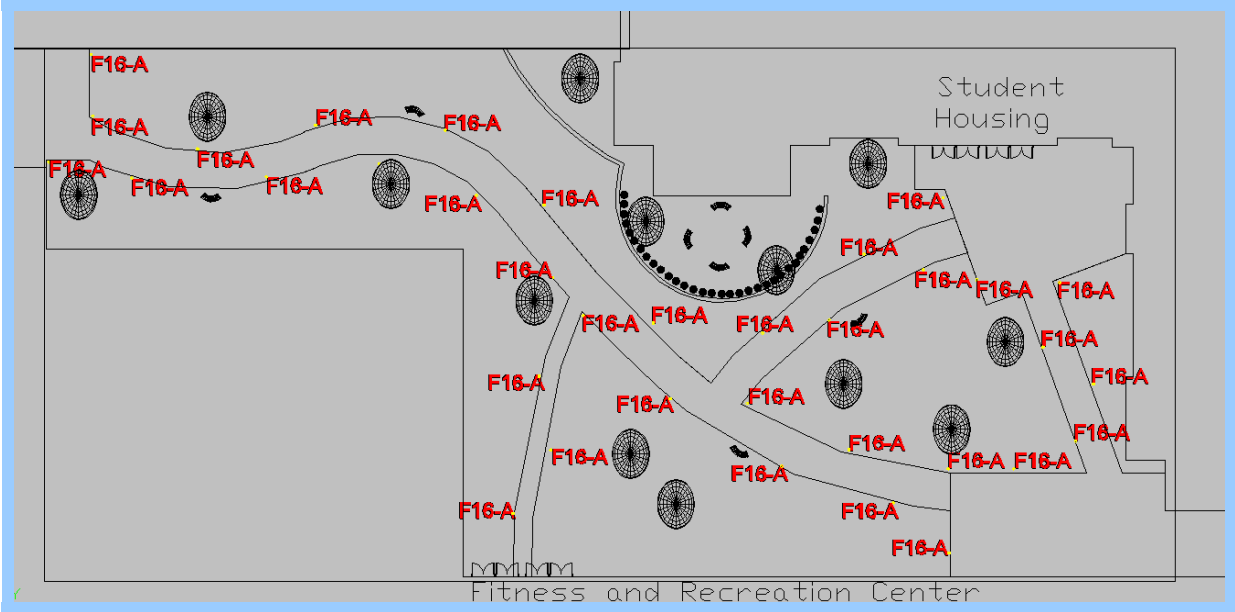
Two different approaches with the same design concept and criteria will be examined. The first design will study dark-sky compliant bollards, while the second design will look at dark-sky compliant pole mounted type fixtures. Below is a sketch of the desired lighting concept. In order to keep some variables constant for a more adequate comparison, each fixture will have the same type of lamp, lamp wattage, and ballast.



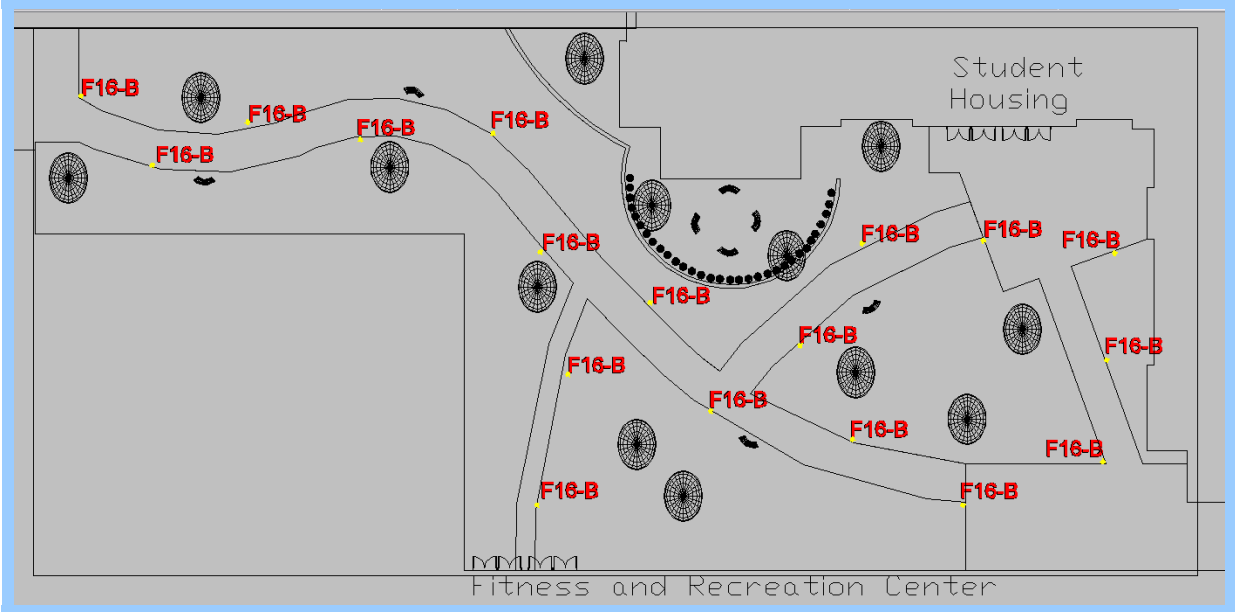


# Lighting Plan

Lighting Layout 1



Lighting Layout 2



Alexis Kreft  
Lighting/Electrical Emphasis  
Dr. Mistrick

*Luminaires Images*



*Luminaire Schedule*

Label	Description	Catalogue NO.	Lamp			Ballast		Voltage	Fixture Qty.
			NO.	Type	Watts	Type	Lamps		
F16-A	360 Degree 3' Bollard	ERCO 33353.023	1	T6 70W G12 MH	70W	Electronic	1	277	35
F16-B	10' Indirect Pole, Site Luminaire, Dark-sky compliant	Gardco Lighting Gaskin Series GSD4-1-10-5ID-T70CMHE-277	1	T6 70W G12 MH	70W	Electronic	1	277	18

*Light Loss Factors*

Luminaire Label	Maintenance Category	LLD	LDD	RSDD	BF	Total LLF
F16-A	IV	0.76	0.86	-	0.98	0.641
F16-B	IV	0.76	0.86	-	0.98	0.641

*Assume: 24 month cleaning interval and a clean environment.*

*Power Density*

Label	Qty	Watts	Total Watts	Label	Qty	Watts	Total Watts
F16- A	35	77	2695	F16- B	18	77	1386
Total:			2695	Total:			1386
Sq Ft:			20000	Sq Ft:			20000
<b>Power Density:</b>			<b>0.13475</b>	<b>Power Density:</b>			<b>0.0693</b>

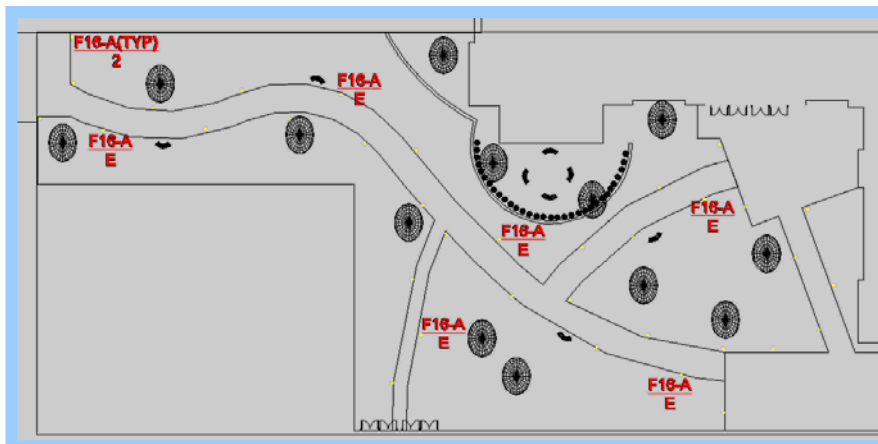


## Control Plan

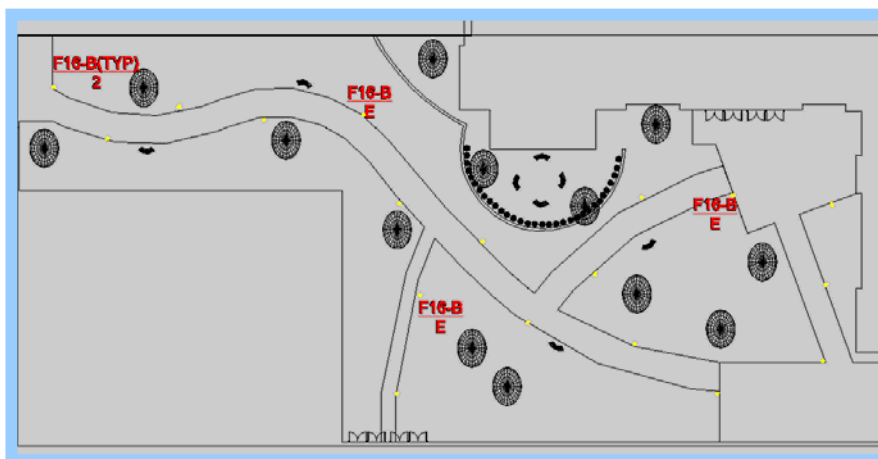
### *Control Equipment:*

All normal branch circuits are circuited to panelboard RL1LNH1, which is a 480/277 panel. Wire all normal lighting fixtures through low voltage lighting control cabinet RLI-LCCN01. All life safety branch circuits are circuited to panelboard RL1LSH1. Wire all life safety lighting fixtures through low voltage lighting control cabinet RLI-LCCE01. All the fixtures in this layout will be on circuit 2. Emergency fixtures will have battery operated ballasts which power the fixtures if the life safety lighting is needed. The panelboard is located on lower level one in the electrical equipment room. The fixtures will be controlled first with a timer and a manual switch will also exist that can override the timer.

### *Switching and Circuited*



*Layout 1 Circuited*



*Layout 2 Circuited*

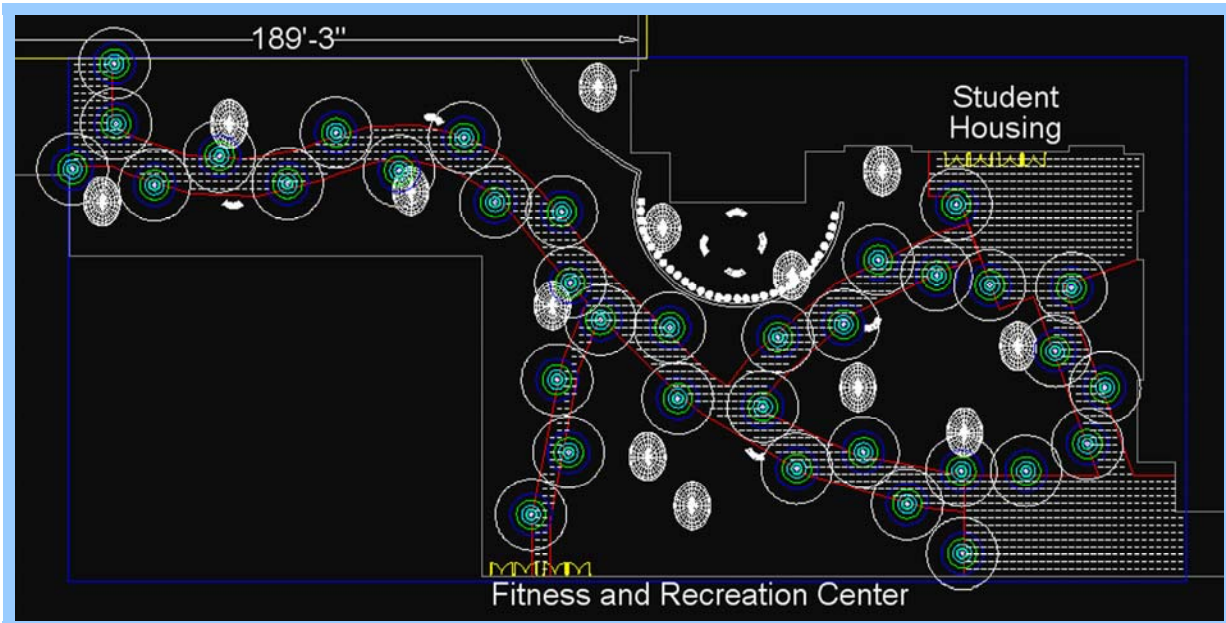
*\*The panelboard schedules are found in the Electrical Depth part of this report under Branch Circuit Redesign/ Exterior.*



## Software Calculations

### *Lighting Plan 1*

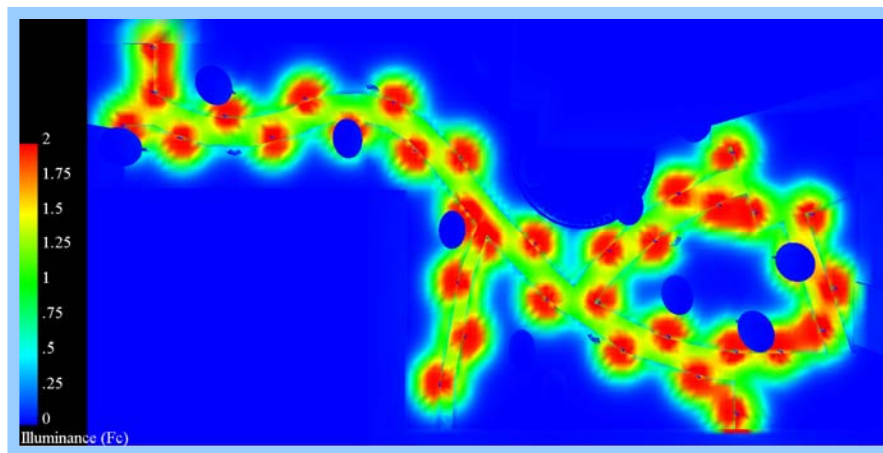
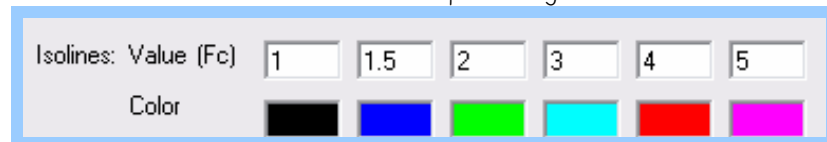
#### *Illuminance levels*



#### **Project 1** **Calc Pts**

**CalcPts**  
Illuminance Values  
(Fc)  
Average=1.60  
Maximum=6.1  
Minimum=0.0

Above shows an AGI simulation of the panoramic bollards. The circles around each fixture represent the illuminance distribution. Below is a chart with the color and corresponding illuminance value.

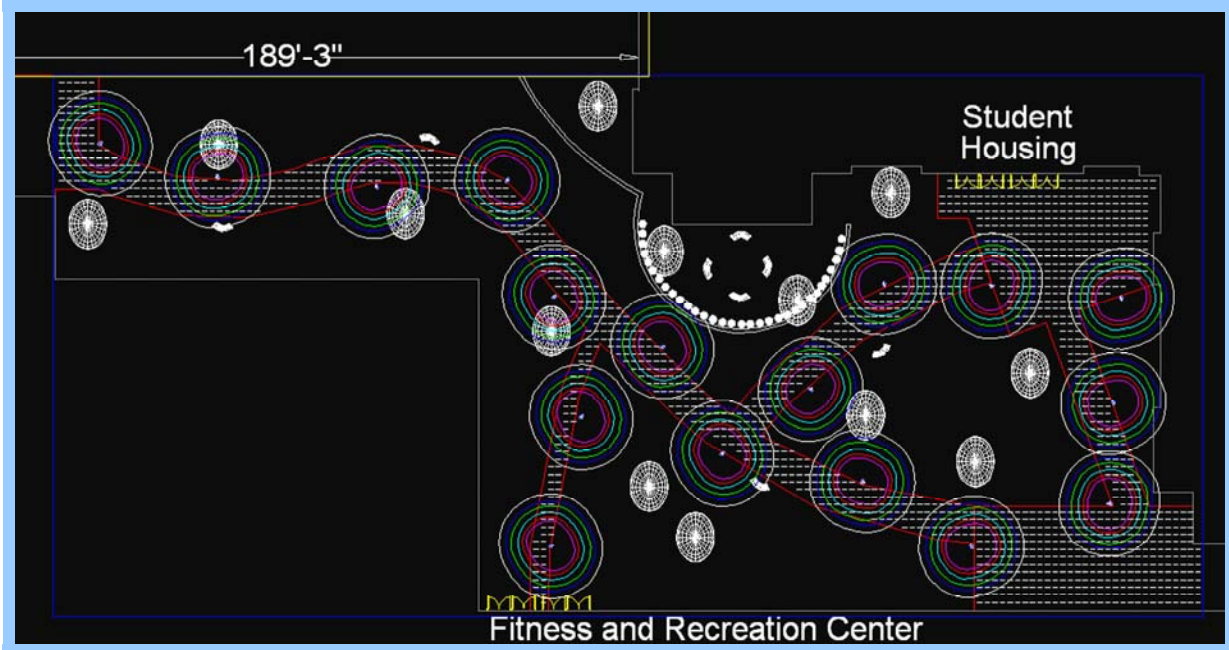


The figure to the left represents the illuminance distribution across the courtyard. The maximum light level reached about two footcandles with an average distribution of 1.6fc. The values are a little low, but adequate levels for an exterior courtyard.



*Lighting Plan 2*

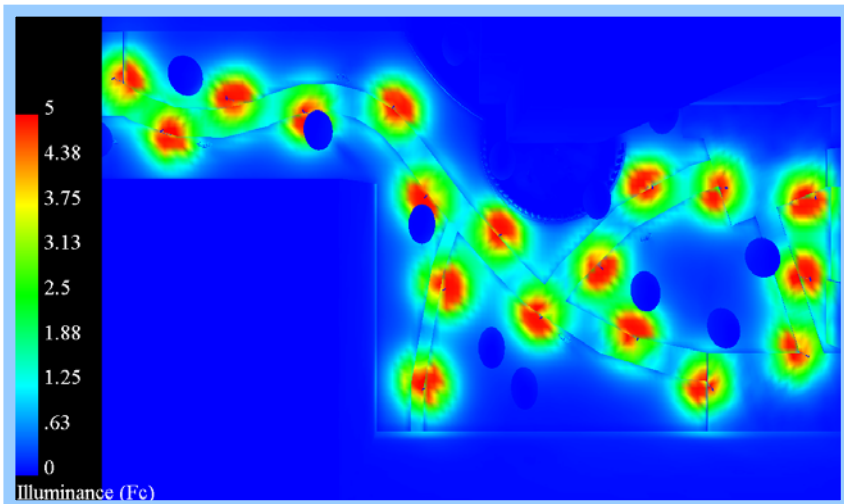
*Illuminance levels*



**Project 1**  
**Calc Pts**

CalcPts  
Illuminance Values (Fc)  
Average=2.30  
Maximum=9.8  
Minimum=0.1

Above shows an AGI simulation of the pole mounted fixtures. The circles around each fixture represent the illuminance distribution. Below is a chart with the color and corresponding illuminance value.



The figure to the left represents the illuminance distribution across the courtyard. The maximum light level reached about five footcandles with an average distribution of 2.3fc. The values reach between the target of 2-5fc, which will allow a safer feel within the courtyard.

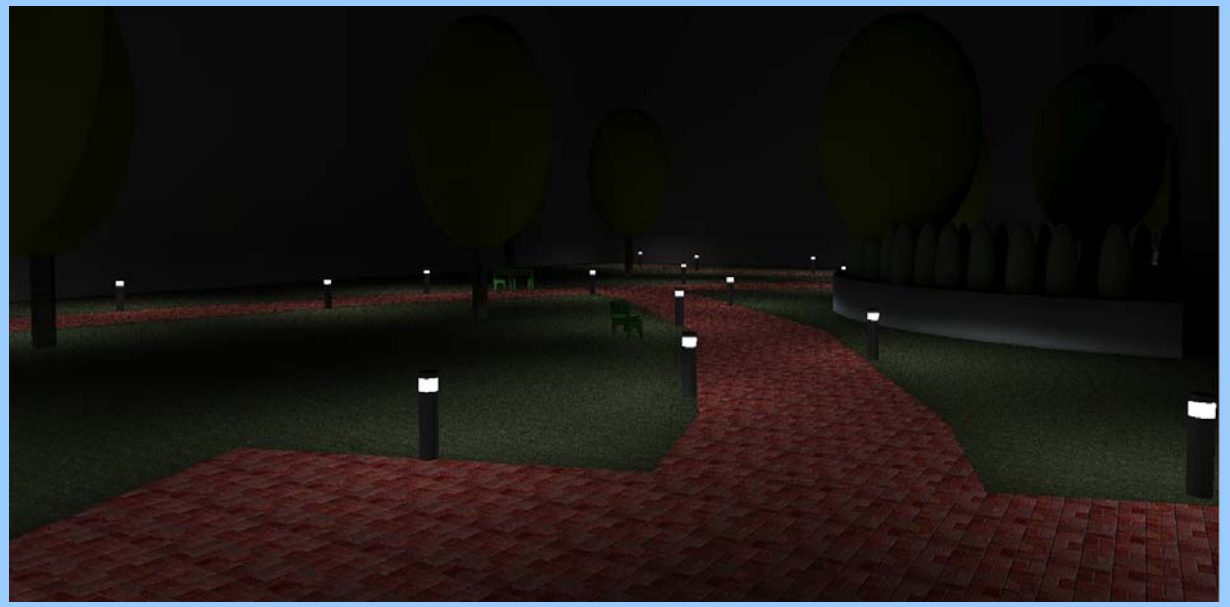


Renderings

*Layout 1 - View from Parking Area*



*Layout 1 - View from Dormitory Entrance*





*Layout 2- View from Parking Area*



*Layout 2- View from Dormitory Entrance*







## Conclusion

The intent of this lighting design analysis was to create two different lighting designs for the courtyard pathways and compare their differences. The main lighting goals for both designs were to implement dark-sky compliant fixtures while creating a safe and secure atmosphere for students at night. In order to keep a few constant variables, the fixtures would use the same type of lamp and wattage. After choosing suitable fixtures, the outcomes of each were very different.

Layout 1 looked at a panorama bollard fixture. The maximum illuminance level reached 2fc. The light was generally evenly distributed along the pathways with an average of about 1.6fc. In order to provide suitable light levels, thirty-five fixtures needed to be used, which increased the power density. The panorama bollards tend to be aesthetically pleasing due to their smaller size and lack of direct glare. Unfortunately, because of the small size and dark-sky compliancy, little to no light reaches vertically enough to provide adequate facial recognition.

Layout 2 examined the use of a dark-sky compliant pole fixture. The indirect fixture provided light on the ground by using of a highly reflective optic fixture design. The maximum illuminance level reached was about 5fc with an average of about 2.5fc along the pathways. The light was evenly distributed and only 18 fixtures were needed in order to provide adequate light levels. The power density turned out to be only half that of Layout 1. The pole fixtures also provide better facial recognition which is important for safety.

After thoroughly looking at each lighting design, I would recommend Layout 2. The pole fixture is in keeping with dark-sky compliancy and is a creative yet modern fixture design. Safety and security is an important goal for exterior campus design, and this fixture provides twice as much light as the bollard with only half the amount of fixtures. The pole fixture also allows better light levels for facial recognition, which provides a better sense of security for pedestrians at night. Overall, Layout 2 is a better lighting design, cheaper (less fixtures to buy and less electricity), and visually pleasing to the eye.